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17 December 1920

N EXPERIMENTAL STUDY OF THE EYE-VOICE SPAN IN READING

By
GUY THOMAS BUSWELL

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CHICAGO, ILLINOIS

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CHAPTER I

INTRODUCTION

PROBLEM

In oral reading the eye always moves at a greater or less distance in advance of the voice. For a mature reader the eye leads the voice by a wide span, which at times amounts to as much as seven or eight words. The immature reader, however, such as a pupil in the primary grades, has a very narrow span. For such a reader the eye does not move from a word until the voice has spoken it, and reading in many cases consists merely of a series of spoken words. The eye-voice span, in that case, is reduced to a minimum. A simple experiment of placing a card over a printed page and uncovering only a word at a time will demonstrate the situation which would exist if the eye and voice were kept very close together. Interpretation of the passage is difficult under such conditions. An eye-voice span of considerable width is therefore necessary in order that the reader may have an intelligent grasp of the material read, and that he may read it with good expression. If words are encountered which are spelled alike but pronounced differently such as "read" (present tense) and "read" (past tense), the correct pronunciation and meaning cannot be determined in many cases until the eye has observed the context by looking ahead. A still further need for a wide eye-voice span is apparent when marks of punctuation are encountered. This need is well illustrated by the reading of children when they arrive at a question mark without having seen it in advance and find their vocal expression entirely unprepared for it. Their failure to respond with a rising inflection of the voice is clear evidence that they were not looking ahead and that they were not getting the thought in large units. The eye-voice span is of real significance, therefore, in the reading process. In the diagnosis of difficulties in reading a measure of the eye-voice span often affords a definite basis for treatment. Treatment not uncommonly involves the construction of definite methods of teaching which will serve to increase the width of the span. The purpose of this study is to determine more fully and accurately the nature of the eye-voice span.

The problem will be considered in three divisions. In the first (*a*) a study will be made of the differences in the width of the eye-voice span in the different grades and in the high school, and (*b*) the variation in the width of the span in different parts of the sentence. In both (*a*) and (*b*) the results will be presented in such a way as to show separately the characteristics of pupils with mature and immature reading habits. Following this, (*c*) a comparison will be made to show the relationship of the width of the eye-voice span to rate of reading, number of fixations per line, and regressive movements.

In the second division (*a*) a very detailed analysis of eye-voice relationship will be made, which will show the exact position of the eye and voice at each eye-fixation and will exhibit the variations in the width of the eye-voice span in the reading of different passages by a single individual. These results will be used (*b*) in an effort to explain the cause of the occasional very long eye-fixations which appear in reading records.

The third division of the investigation will make use of a test device, consisting of a paragraph containing several words spelled alike but pronounced differently, by which the eye-voice span in oral reading will be studied in relation to the recognition of meaning in silent reading.

PREVIOUS STUDIES

Previous to this time the subject of this investigation has appeared, so far as the writer can discover, only twice in the literature of experimental studies of reading. In 1897 Quantz[1] did some work on the problem without the use of elaborate apparatus. His experiment was carried out by quickly slipping a card over the page while the subject was reading and recording the number of words spoken after the view was cut off. The method gave results which, for two reasons, are not directly comparable with those of the present study. The first is that the method did not record the location of the eye's fixation at the instant the view was cut off, but recorded the number of words which could be correctly given. In ordinary reading material more words could be given than were actually seen, by simply filling out the content of the meaning. This would cause a considerable error in the results which might have been partly reduced by the use of non-sense material instead of the meaningful material used. The use of such material would, however, have introduced another difficulty due to the fact that non-sense material is not normal reading-matter. The method used by Quantz gave an apparently wider eye-voice span than actually existed. The second factor which would cause a difference in results from those of the present study is that by Quantz's method the number of words recorded would include all which were seen even to the limits of the perceptual area, while by the method of this investigation the location of the eye is recorded at a point within the fixation area. This again operates to give a wider span for Quantz's study.

---

[1] J. O. Quantz, "Problems in the Psychology of Reading," *Psychological Review Monograph Supplement*, Vol. II, No. 1. 1897. Pp. 1–51. Princeton, N.J.: Psychological Review Co.

Quantz computed the correlations between eye-voice span and rate of reading and between eye-voice span and the positions in the line. He found a high correlation between reading rate and the width of the eye-voice span. He also found that the span depended to a great extent upon the point in the line at which the view was cut off. He reports an average span of 7.4 words at the beginning of a line, 5.1 words in the middle, and 3.8 words at the end of the line.

The second reference which has been made to this problem is found in the study made by C. T. Gray[1] in 1917. Gray's report gave seven plates showing the readings of six subjects, one from the seventh grade, two from the high school, and three from college students. No detailed analysis of the records was made and no correlations were given, but his conclusions were summed up in the statement that "the separation between eye and voice in oral reading varies from individual to individual or from point to point within the same selection."

With the exception of these two brief references, no previous investigations appear in the literature canvassed by the writer.

APPARATUS AND METHOD OF PRESENT STUDY

The apparatus and general method of this investigation are the same as used by C. T. Gray and other investigators in the Chicago laboratory. They are fully described in Gray's[2] monograph. One change was made in the equipment there described. The hand-feed arc lamp was discarded and a new three-wire automatic arc was installed in its place. This lamp is automatically fed by a magnetic release and has the advantage of producing a beam of light of constant intensity and at a constant point of location.

Without describing the apparatus in detail, it may be well to describe in general the method of this investigation. It consists of photographing a beam of light, generated by the arc lamp, reflected first to the cornea of the eye from silvered glass mirrors, and then from the cornea through a camera lens to a moving film. The pencil of light changes its direction with each movement of the eye. The subject reads and a photograph is made on the film which records the movements of the eye as a sharply focused line. An electrically driven tuning-fork, with a vibration rate of fifty times per second, is mounted in the path of the beam of light in such a way that the light is intercepted at each vibration. These vibrations produce on the film a line of dots rather than a solid line, each dot representing a time of exactly one-fiftieth of a second. Since the film is moved continuously in the vertical plane, the record shows a vertical line of dots while the eye is fixated in a single position, and a short horizontal line when the eye is in motion in a horizontal or oblique direction. Vertical movements of the eye are lost. A second line, the head-line, is obtained on the film by the reflection of the light from a bright nickel-plated bead fastened to the rim of a pair of spectacles worn by the reader. This line shows any head movement which may occur, and since it is impossible to eliminate all head movement, this line is of the greatest importance. Every eye-fixation is located with reference to the position of the head-line, and by this means correction is made for all head movement. This brief statement of apparatus and method may be supplemented by the very detailed explanation given in Gray's monograph.[1]

---

[1] C. T. Gray, "Types of Reading Ability as Exhibited through Tests and Laboratory Experiments," *Supplementary Educational Monographs*, Vol. I, No. 5. Chicago: University of Chicago Press, 1917. Pp. 106–20.

[2] *Ibid.*, pp. 83–90.

The method of determining the location of the fixations on the printed lines from the film record has not been adequately described in previous studies. This part of the technique is of sufficient importance to receive a careful explanation here. Plate I shows the film record for the first two lines read by Subject H5. On this plate, line *xy* is the head-line made by the reflection from the metal bead. The upper part of the line shows little head movement, but the lower part shows such movement very distinctly. Movements of the head such as occur at the lower part of the plate would cause an error in locating fixations of as much as four or five letters, if the head-line were not provided for correction. Many head movements, especially for children in the lower grades, are much greater than those shown by this subject.

The eye record made by the light reflected from the cornea is shown in the lines *cd* and *ef*. The line *cd* represents the reading of the first line of the paragraph, and the line *ef* the reading of the second. The vertical lines of dots show the fixations of the eye. The horizontal line *de* shows the movement of the eye from the end of the first line to the beginning of the second. Since each dot on the film represents one fiftieth of a second, this movement from line to line consumed two fiftieths of a second. By counting the dots it will be found that the last fixation of the first line took nine fiftieths of a second, and the one just before it, twenty-three fiftieths.

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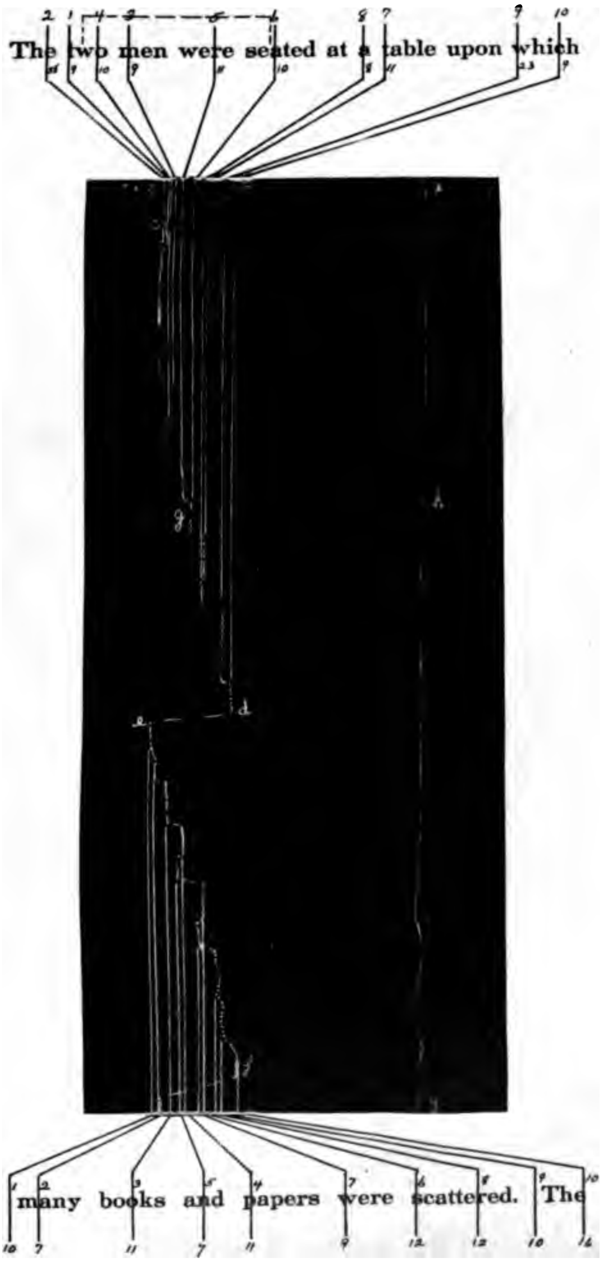
[1] C. T. Gray, *op. cit.*, pp. 86–90; 106–20.

PLATE I



Location of fixations from film record on lines of print, Subject H5

The points *a* and *b* on the plate are related to the printed matter read by having the reader fixate his eyes upon a dot placed just above the first letter of the first line, and then upon another dot just above the last letter of the line. The fixation for the first dot cannot be shown on this small section of the film, but the point *a* lies in the vertical extension of that fixation. The point *b* lies in the path of the fixation on the second dot, a few dots of the fixation showing just below *b*. The distance, therefore, from point *a* to point *b* equals the distance covered by a movement of the eyes from one end of a line of print to the other, and all fixation movements will fall on the film between lines extended vertically from these points. If the film were further enlarged until point *a* rests over the first letter of the first line and point *b* over the last letter, the vertical projections of the fixations would fall exactly over the letter upon which the eye was fixated at that time. For the first line shown in the plate, the first fixation would fall exactly over the first letter of the word "two"; the second fixation would fall exactly over the last letter of "the"; the third fixation would fall exactly over the first letter of "men"; etc. It was by this method that all of the films were translated into positions of the eye on the printed lines. The film was run through a stereoptican projection apparatus which enlarged the record on a screen until the points represented on the plate by *a* and *b* exactly coincided with the edges of the paragraph. The film was then wound through the stereopticon on a spool, and the location of each fixation marked on the letter over which it passed. The length of the fixation was recorded at the same time by counting the dots on the film. In Plate I, the fixations are connected by vertical extensions to the line connecting points *a* and *b*. The lines drawn from these projections to the words intersect the words at exactly the place where the fixations would be located if the film were enlarged until line *ab* was equal to the width of the printed line.

In order to get a record of the voice the photograph was supplemented by a dictaphone record of the oral reading taken for all subjects at the same time the photograph was made. The speaking tube of the dictaphone was placed directly in front of the reader's mouth. In order to record the exact relation to the eye-movements on the film, the speaking tube was divided, one section being attached to a box containing a tap-bell operated by an electric switch. This same switch also operates a camera shutter with its action reversed so that it is normally open instead of closed. The shutter is placed in the path of the beam of light in such a manner that when the switch is operated quickly the beam of light is shut off for an instant and the bell rings at the same time. The breaks in the photograph and the bell signal on the dictaphone record thus make it possible to synchronize the operations of the eye and voice. A typical interception on the film is shown in a short gap in the film line in Plate I, at point *g* on the eye-line and *h* on the head-line. The bell records a sharp click on the dictaphone wax record at the same time. In Plate I the break in the eye-line occurred during the sixth fixation at point *g*. This point on the printed copy falls on the third letter of the word "seated." The dictaphone recorded the click of the bell at the same time that the subject was pronouncing the word "two." This means that when the subject was pronouncing "two" his eye was fixated upon the word "seated." The interval from "two" to "seated," as marked on the plate by a dotted line, shows the distance that the eye was ahead of the voice. This is the interval spoken of as the eye-voice span. The eye-voice span could be determined at any desired place in the reading by simply pushing the switch key at the time the subject pronounced that particular word. This was done nine times in the reading of each elementary pupil, and eight times during the reading of each high-school pupil. The wax record gave a means of checking the movement to see if it occurred at exactly the place desired. If it should occur too soon or too late the dictaphone furnishes a means of correction.

SUBJECTS EXAMINED IN THE PRESENT STUDY

Photographs were taken of the readings of fifty-four different subjects selected as follows. Two good and two poor readers were selected from each of the elementary grades above the first, on the basis of scores made in William S. Gray's Oral Reading Paragraphs. Three good and three poor readers were selected through the co-operation of the English department and the high-school principal from each of the four high-school classes. Six adult college students were selected at random and ranked into two divisions, one better than the other. The three poorer adult subjects were, however, fairly good readers. The entire group of subjects, therefore, included twenty-four from the elementary school, twenty-four from the high school, and six college students, each grouping being made up of equal numbers of good and poor readers. Great care was used in the selection of these groups in order that all the characteristics of the subjects might be known in advance so as to clear the way for concentration of attention during the investigation on the one matter of the eye-voice span. The reading rate of all subjects was taken at the time of the experiment, using material of the same degree of difficulty as that used for the photograph.

PLATE II

The kitten pulled at the veil and wreath of flowers with her cunning paws. Little by little she drew them to the edge of the box. At last she poked her head right through the wreath, but she couldn't get it out again.

The two men were seated at a table upon which many books and papers were scattered. The older man turned to a page in a large book and began to read. The subject of the chapter was something about hypnagogic hallucinations and hyperaesthesia. A few pages further on he came to a sentence which read, "One thing, however, is obvious, namely, that the manner in which we become acquainted with complex objects need not in the least resemble the manner in which the original elements of our consciousness grew up."

Selections used for the experiments

CHAPTER II

THE EYE-VOICE SPAN

DETAILED STATEMENT OF METHOD

Units of measure.—Throughout the study the unit of time measure is one-fiftieth of a second, corresponding to the vibration rate of the tuning-fork time-marker. In all of the plates shown the length of fixations is given by the row of figures beneath the printed line, and is recorded in units of fiftieths of a second.

The unit of measure for the width of the eye-voice span is one letter-space. The term "letter-space" may be defined as the space taken by one letter or one punctuation mark, or the blank space between words. This unit is an arbitrary one, but is constant throughout the study. For the selections used the average number of letter-spaces per word is five. Therefore the denomination of any of the results may be transposed from letter-space units to word units by dividing by five.

Reading selections used.—The reading selections used for this part of the study are reproduced in Plate II in the same form and size of type as used in the experiment. The upper selection, taken from one of the Courtis silent-reading tests,[1] was read by the pupils selected from the elementary grades. This paragraph was chosen because it was desirable to use a selection which was not too difficult for second-grade children, but could be used also for the pupils of the five higher grades. The paragraph was found to be well adapted to this purpose. The selection used for the elementary pupils was necessarily shorter than that used for high-school students, since the younger children read more slowly and the time for taking the photograph was limited by the length of the film. The films used were forty-two inches long, and in passing through the camera allowed fifty seconds of reading time. The elementary pupils were directed to "read naturally just as you would if you were reading in class for your teacher." From all objective evidence the pupils did read naturally and were not disturbed by the apparatus. The subjects from the second grade carried out the experiment fully as well as those from the higher classes. When the subjects began to read they apparently forgot about the apparatus and centered all their attention upon the reading.

---

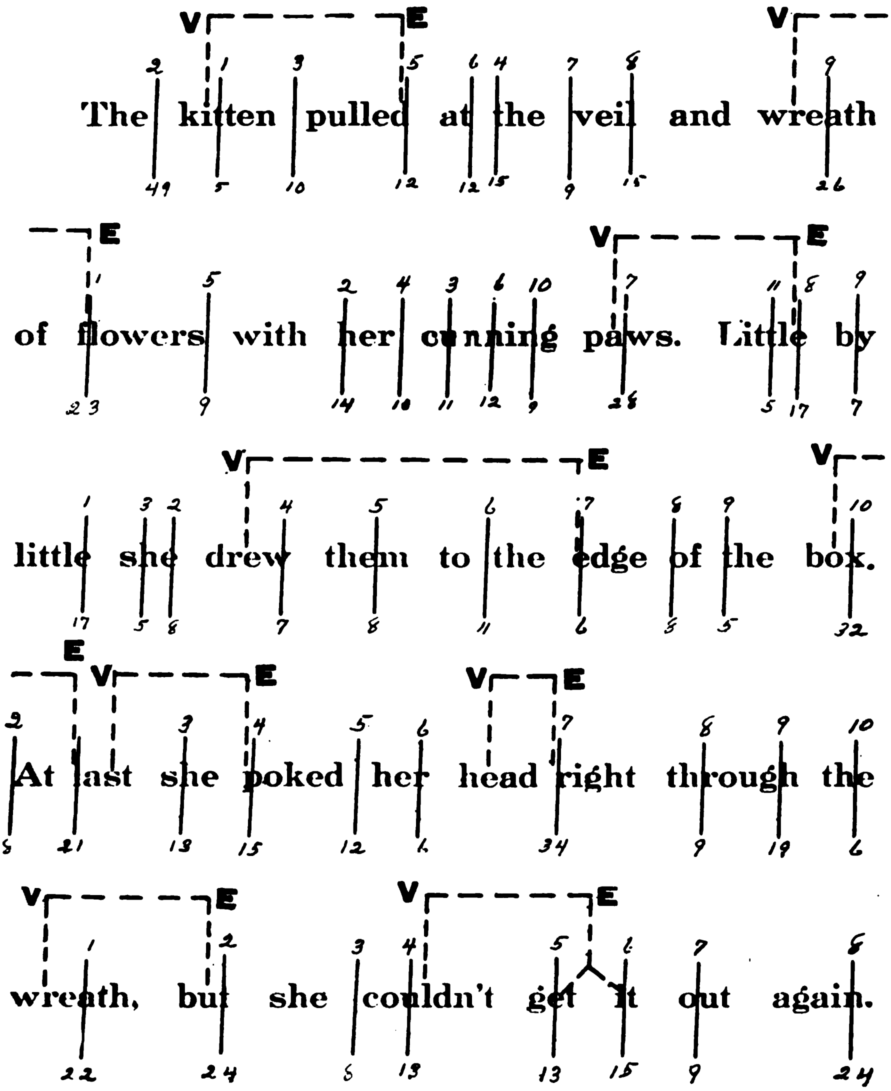
[1] S. A. Courtis, "The Kitten Who Played May-Queen," Silent-Reading Test No. II, Form I. *Standard Research Tests.* Detroit: S. A. Courtis.

The selection shown in the lower part of Plate II was used for the high-school and college students. It was constructed with three purposes in mind. The first aim was to provide a few lines of easy, normal reading-matter. The first four lines provide this. The second purpose was to introduce a few new and difficult words to find the reaction to that kind of a situation. The three words in lines five and six were therefore introduced, and were found to be new to all of the high-school subjects. The third aim was to introduce a sentence made up of easy words but containing a difficult thought. The last sentence in the paragraph taken from James' *Principles of Psychology*, satisfied this requirement. The subjects were directed to "read the paragraph naturally, just as you would a newspaper. If you meet any new or difficult words, pronounce them the best you can and go on. Try to remember the thought well enough so you could tell what you have read if asked to do so." The introduction of the three difficult words in lines five and six caused such a disturbance of the eye-movements that the results for these two lines are entirely omitted in the table of general data and in all general averages given throughout the study. The difficulties encountered will, however, be given special treatment in the next chapter.

Explanation of typical records.—In order that the discussion in this report may be more easily followed, a detailed explanation of the plates of two typical subjects will be given here. Plate III shows such a record from a pupil belonging to the elementary school and Plate IV, one from a student in the high school.

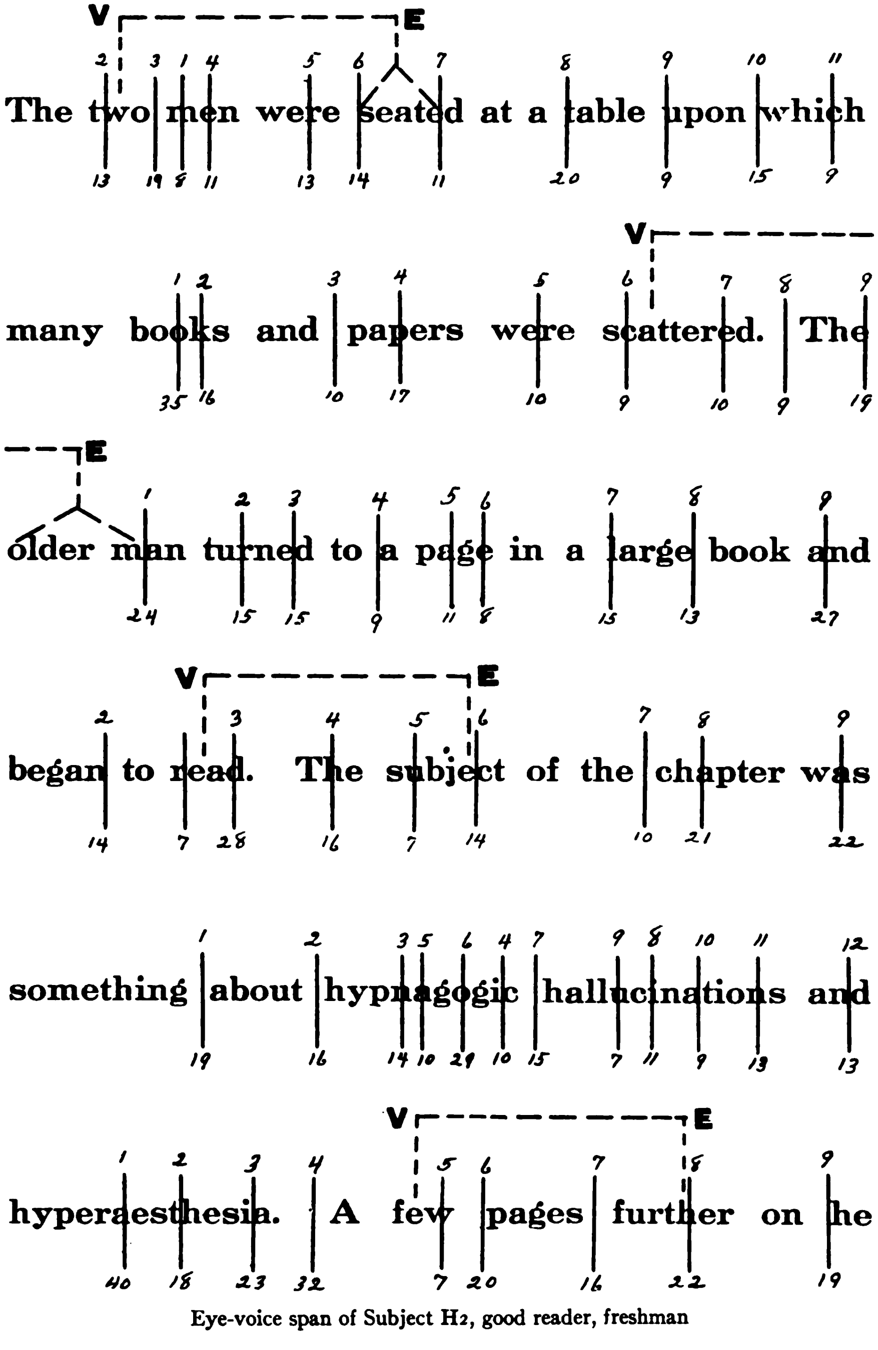
Plate III shows the oral reading of a poor reader from the fourth grade. The short vertical lines drawn through the words indicate the points of eye fixations. The serial numbers above the vertical lines indicate the order of the fixations, while the numbers at the lower end of the lines indicate the lengths of the fixations in fiftieths of a second. Referring to the first line of this plate it will be seen that the first fixation fell upon the word "kitten" and that the eye remained there for five fiftieths of a second. The subject evidently did not feel sure of the beginning of the line, as indicated by the position of the second fixation which fell just after the first word of the line. The eye remained fixed at this point for forty-nine fiftieths of a second. The third fixation was located just before the third word and lasted for ten fiftieths of a second. The succeeding fixations may be observed by following the upper series

PLATE III


The kitten pulled at the veil and wreath
of flowers with her cunning paws. Little by
little she drew them to the edge of the box.
At last she poked her head right through the
wreath, but she couldn't get it out again.
V
E

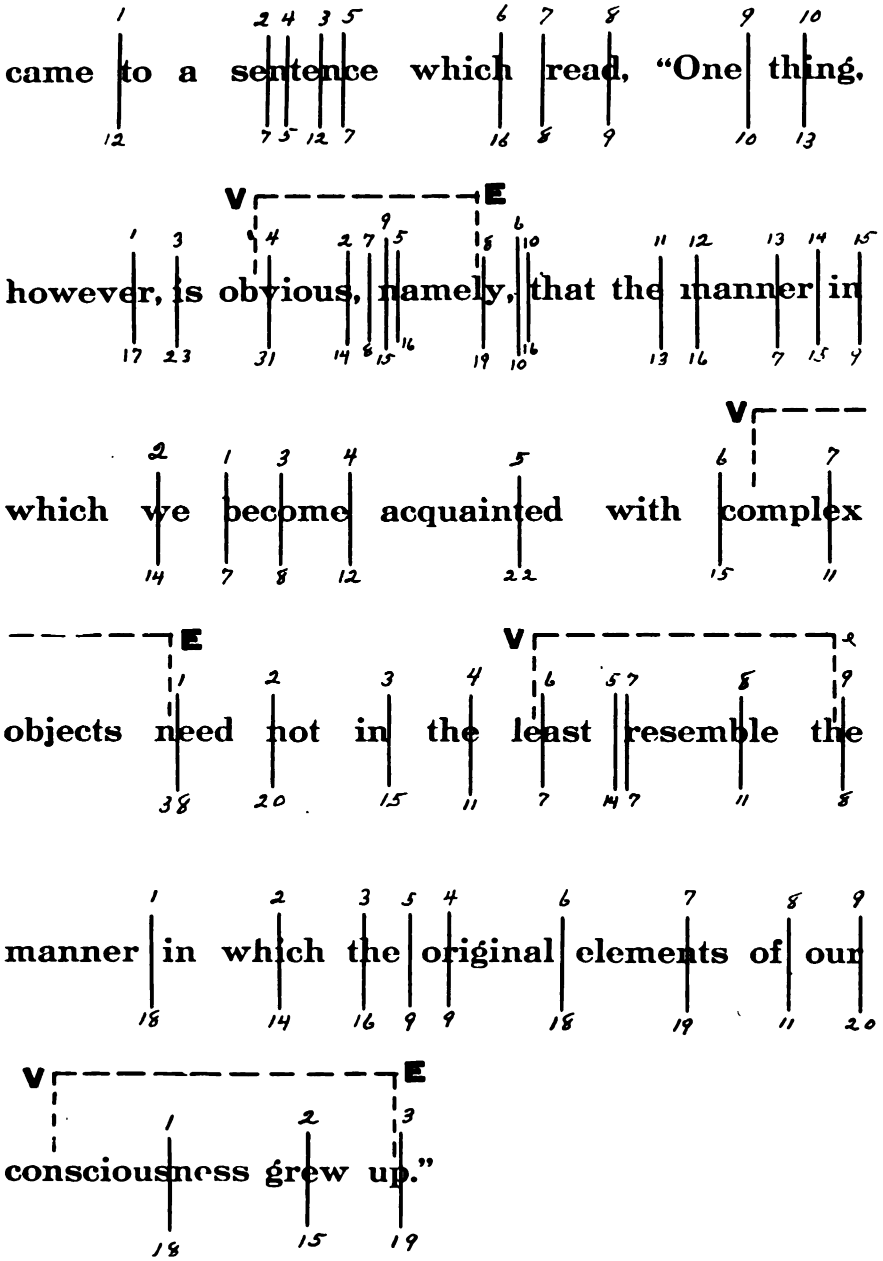
Eye-voice span of Subject E12, poor reader, Grade IV

PLATE IV


V
E
The two men were seated at a table upon which
many books and papers were scattered. The
older man turned to a page in a large book and
began to read. The subject of the chapter was
something about hypnagogic hallucinations and
hyperaesthesia. A few pages further on he

Eye-voice span of Subject H2, good reader, freshman

PLATE IV*a*



came to a sentence which read, "One thing, however, is obvious, namely, that the manner in which we become acquainted with complex objects need not in the least resemble the manner in which the original elements of our consciousness grew up."

Plate IV—*Continued*

of numbers in order. The function of this investigation is concerned with the eye-voice span rather than with the nature of these fixation pauses. A very thorough analysis and interpretation of eye-movements and fixations in reading have been made in another monograph of this series.[1]

The eye-voice separation is shown, for several typical positions, in Plate III by a bracket of broken lines. The position of the voice is marked by the letter *V* and the position of the eye, by the letter *E*. Referring to the first line of this plate, it will be seen that when the voice was pronouncing the word "kitten" the eye was fixated on the last letter of the third word. If the number of letter-spaces included in the bracket connecting the positions of the voice and eye are counted, it will be found that the eye-voice span at this position is 11 letter-spaces. The eye-voice span was next measured at the end of the first line. As the voice was pronouncing the first part of the word "wreath," the eye was fixated on the first letter of the word "flowers" in the next line, making an eye-voice span of 8 letter-spaces plus the time consumed in moving back to the beginning of the line. Likewise, when the voice was pronouncing "paws" the eye was fixated on the last letter of "little," making a span of 9 letter-spaces. In the last line of Plate III the voice was pronouncing the word "couldn't" just as the eye was moving from the fifth to the sixth fixation. This occurred frequently, and in such cases the span was measured from the position of the voice to a point half-way between the two eye fixations, as shown by the branching of one arm of the bracket in this case.

As explained in the preceding chapter, the operation by which the positions of the eye and voice were determined was controlled by an electric switch. It was therefore possible to measure with exactness the eye-voice span at any desired position in the paragraph by simply pressing the connection at that point in the reading. For the sake of comparisons, nine positions were selected in the passage read by elementary pupils. These positions are shown in Plate III by the letter *V*, at the beginning of the brackets, which occurs just above the word which was being spoken at the time the measure was taken. These positions, in order through the elementary selection, occurred at the words "kitten" and "wreath" in line 1, "paws" in line 2, "drew" and "box" in line 3, "last" and "head" in line 4, and "wreath" and

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[1] C. H. Judd and others, "Reading: Its Nature and Development," *Supplementary Educational Monographs*, Vol. II, No. 4. Chicago: University of Chicago Press, 1918.

"couldn't" in line 5. In general, the measure was taken at the time the voice was pronouncing the first part of the word. Any variations from this were checked and corrected by means of the dictaphone record. Two of these positions occur at the beginning of a sentence, five within a sentence, and two at the end of a sentence. Also, three occur at the beginning of a line, four near the middle of a line, and two at the end of a line. The location of the positions of measurement in this way makes possible not only an analysis of the eye-voice span by positions, but also makes a uniform distribution from which the average span can be regarded as representative of the paragraph as a whole.

Plate IV gives a typical reading by a high-school pupil. The plate shows the oral reading of Subject H2, a good reader from the freshman class. The method of indicating fixation and eye-voice span is the same as just described for Plate III. In this paragraph eight positions were selected for measuring the eye-voice span. These positions, in order through the paragraph, occurred at the word "two" in line 1, "scattered" in line 2, "read" in line 4, "few" in line 6, "obvious" in line 8, "complex" in line 9, "least" in line 10, and "consciousness" in line 12. Two positions occurred at the beginning of a sentence, three within a sentence, and three at or near the end of a sentence. The positions are also distributed according to position in the line.

A question may arise here whether an average eye-voice span, computed from eight or nine positions in a paragraph, is an adequate measure of the general character of the span for every word in the whole paragraph. In chapter iii of this report, a complete analysis showing the eye-voice span at every word and every fixation in the selection will be given, and a comparison will be made with the results obtained from the eight and nine position measures. The comparison shows a small variation in the average span obtained by the two methods.

Table of general data.—In Table I the general data for all subjects are shown. The elementary subjects' numbers are given the prefix E, the high-school subjects H, and the adult college students A. The table gives the subject number, school grade, quality of reading, average eye-voice span, average variation from the average, average number of fixations per line, average number of regressive movements per line, and rate of reading in number of words read per second. This table is intended only for general reference, summaries being given in later tables. It is analyzed in detail throughout the remainder of this chapter.

TABLE I

General Data for Oral Reading—All Subjects*

Subject	Grade	Quality	Average Eye-Voice Span	Average Variation	Average Number Fixations per Line	Average Number Regressive Movements per Line	Rate of Words per Second
E1	II	G	11.8	2.5	10.8	3.0	2.5
E2	II	G	10.3	3.9	9.0	1.8	2.5
E3	II	P	3.4	1.1	18.6	5.8	0.3
E4	II	P	7.4	4.1	12.0	3.4	1.0
E5	III	G	12.7	2.8	9.4	1.1	2.2
E6	III	G	13.7	2.6	9.0	3.1	3.6
E7	III	P	8.0	2.8	19.7	5.5	2.1
E8	III	P	12.6	3.6	14.0	2.6	2.3
E9	IV	G	11.1	5.0	7.8	1.0	3.3
E10	IV	G	16.6	7.5	7.5	1.2	4.0
E11	IV	P	4.0	1.4	11.2	1.2	1.3
E12	IV	P	8.2	2.3	9.4	1.4	3.4
E13	V	G	19.7	3.3	6.8	1.6	3.7
E14	V	G	13.9	5.0	9.6	1.4	2.5
E15	V	P	12.4	4.8	9.2	1.2	2.8
E16	V	P	7.0	2.6	11.8	3.2	3.4
E17	VI	G	14.9	4.1	8.4	2.0	3.7
E18	VI	G	8.9	4.4	7.0	1.4	4.0
E19	VI	P	8.0	1.5	9.4	2.0	3.2
E20	VI	P	14.4	2.5	7.0	1.2	2.0
E21	VII	G	12.0	4.3	8.2	0.8	4.2
E22	VII	G	19.7	3.4	7.6	1.0	3.5
E23	VII	P	11.4	4.2	8.4	1.8	3.1
E24	VII	P	7.3	2.3	12.2	3.0	2.9
H1	F	G	19.8	4.6	7.7	2.1	3.9
H2	F	G	14.2	1.5	9.6	1.0	3.3
H3	F	G	13.3	1.1	7.9	1.4	4.4
H4	F	P	10.0	0.7	10.0	2.2	2.9
H5	F	P	12.0	2.0	10.5	1.9	3.6
H6	F	P	12.4	3.5	11.9	2.4	3.4
H7	So	G	12.0	5.2	8.3	1.5	3.9
H8	So	G	15.5	5.0	8.1	1.6	3.5
H9	So	G	16.0	4.7	7.2	0.2	3.9
H10	So	P	14.1	3.3	8.3	1.5	4.4
H11	So	P	9.6	2.5	9.2	1.4	3.6
H12	So	P	13.8	2.0	8.3	1.3	3.9
H13	J	G	13.8	2.9	6.4	0.4	4.6
H14	J	G	17.7	4.2	8.1	1.6	4.2
H15	J	G	12.3	1.9	10.9	2.3	3.2
H16	J	P	8.5	2.4	9.8	1.2	4.5
H17	J	P	4.7	2.0	9.3	2.0	3.3
H18	J	P	11.5	0.5	10.7	0.9	3.7
H19	Se	G	12.8	3.5	7.4	0.2	4.3
H20	Se	G	23.0	7.0	9.9	1.3	4.8
H21	Se	G	12.0	3.3	9.9	0.7	3.4
H22	Se	P	13.9	3.6	10.7	3.2	3.7
H23	Se	P	10.8	1.3	10.7	1.2	3.4
H24	Se	P	12.4	2.9	7.5	1.5	3.9
A1	C	P	12.2	1.1	8.3	1.4	3.6
A2	C	P	9.3	4.4	9.7	1.0	3.9
A3	C	P	13.6	3.7	8.9	1.3	3.9
A4	C	G	17.8	4.3	9.0	2.0	4.4
A5	C	G	20.3	0.9	9.2	2.5	4.2
A6	C	G	18.6	1.8	6.4	0.4	3.6

* Lines 5 and 6 omitted in high-school and adult averages. G = Good; P = Poor.

ANALYSIS OF EYE-VOICE SPAN

An interpretation of the significance of the variations in eye-voice span can best be made by studying the relationships between these variations and other known factors of the reading process. A large amount of valuable information has been developed in recent years concerning reading rate and quality, and the characteristics of eye-movements and fixations. A correlation of the eye-voice span with some of the known factors will determine which types of eye-voice separation are indicative of mature and of immature reading habits. Accordingly, an analysis of the eye-voice span will be made showing correlations (*a*) with quality of reading throughout the school period, (*b*) with various positions in the sentence, (*c*) with reading rate, (*d*) with the number of fixations, and (*e*) with regressive movements. After such an analysis the significance of the eye-voice span can be more definitely stated.

Relation to quality of reading throughout the school grades.—The subjects for this experiment were carefully selected, as stated in an earlier paragraph, on the basis of quality of reading, making two equal groups, one composed of good readers and the other of poor readers. By comparing the average eye-voice spans of these two groups the correlation with quality of reading becomes apparent. The subjects were also selected from each elementary grade above the second and from each high-school class. The purpose of this method of selection was to make possible a study of the development of the eye-voice span through the grades. Table II shows the average eye-voice span of twenty-four elementary pupils by school grades and also by quality of reading. Figure 1 expresses the same facts graphically. The table shows the average eye-voice span for all the good readers to be 13.8 letter-spaces, for the poor readers 8.7 letter-spaces, and for the whole group of 24 pupils taken together 11.3 letter-spaces. The superiority of the good

TABLE II

AVERAGE EYE-VOICE SPAN BY GRADES—ELEMENTARY SUBJECTS

SUBJECTS	GRADE						AVERAGE FOR ALL GRADES
	II	III	IV	V	VI	VII	
Good readers.....	11.0	13.2	13.9	16.8	11.9	15.9	13.8
Poor readers.....	5.4	10.3	6.1	9.7	11.2	9.4	8.7
Good and poor...	8.2	11.8	10.0	13.3	11.6	12.7	11.3

readers in width of eye-voice span is very great, the average for all grades being 58 per cent wider than that of the poor readers. The average span of the good readers is also wider than that of the poor readers in every grade, being greater by 103 per cent in the second grade, 28 per cent in the third grade, 127 per cent in the fourth grade, 73 per cent in the fifth, 6 per cent in the sixth, and 69 per cent in the seventh. These results make it perfectly clear that for elementary pupils a wide eye-voice span is a factor of good reading and a narrow span is a factor of poor reading. Whether this factor is in the nature of a cause or an effect will be considered later.

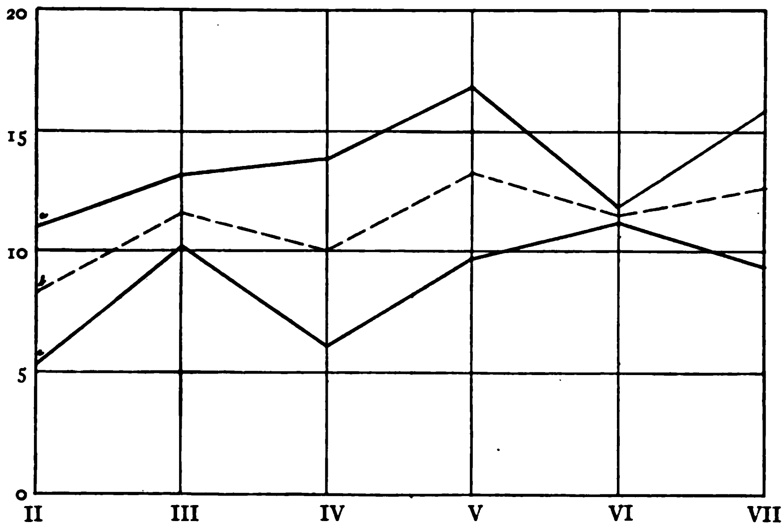


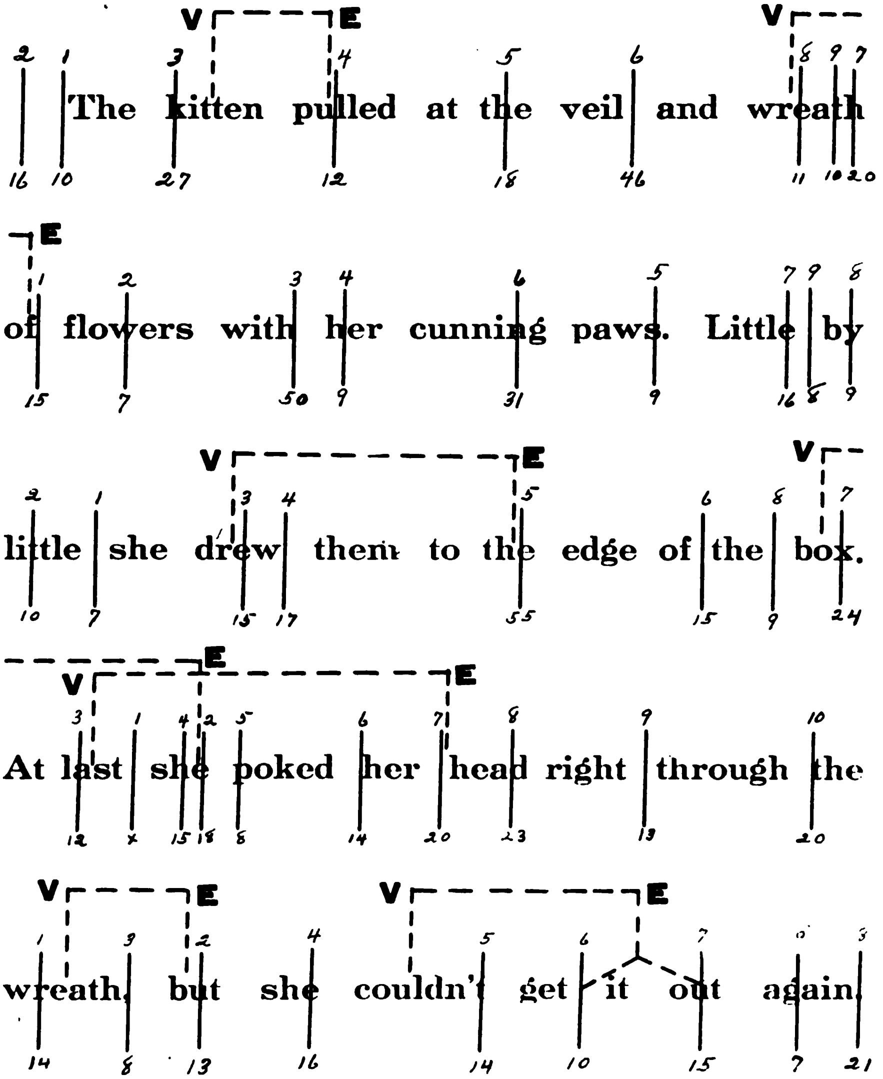
FIG. 1.—Average eye-voice span by grades—elementary subjects. The grades are shown on the horizontal axis. The width of the eye-voice span in letter-spaces is shown on the vertical axis.

A development in the width of the eye-voice span through the grades is also shown by Table II and Figure 1. Following the upper line in Figure 1, for the good readers, the progress shows a general upward direction until the sixth grade is reached, where a sudden drop occurs. This drop is apparently due to a very extreme variation in a single individual rather than to a characteristic of the grade in general. Subject E18, who was a good reader in the sixth grade, had an average eye-voice span which was lower than that of any other good reader, even those in the second grade. The low average of the good readers for this grade is due to this exceptionally narrow span. This subject showed all the other characteristics of a good reader, and no explanation appeared, as far as could be discovered, for the very narrow span except that it was an extreme individual variation. The development of the span through the grades for both good and poor readers was irregular, but a general upward tendency of the line is noticeable. Evidently this development is interfered with in the training of some pupils.

Plates III and V–XV show the readings of one good and one poor reader from each of the elementary grades. A study of some of these individual records will reveal many characteristic variations in oral reading. Plates V and VI give the readings of a good and a poor reader from the second grade. Subject E2, the good reader, has an average span of 10.3 letter-spaces. The width of the span in the two positions measured in the first line is much narrower than in the positions in the third and fourth lines. Such a variation for a subject, within a selection, is a characteristic in some degree of all readers. Plate VI shows the reading of Subject E3, a second-grade pupil and the poorest reader tested. The whole character of his eye-movements is different from that of E2. The average eye-voice span of E3 is only 3.4 letter-spaces. In the first line for the second word there was no span at all, the eye being fixated upon the word "kitten" at the same time it was being spoken. At the beginning of the fourth line a span of only 3 letter-spaces is found. The dictaphone record showed that this subject did not know all of the words of the selection and had not mastered his phonics sufficiently to help himself. Several words were apparently spelled out before they were pronounced. It is plainly evident that reading for this subject was little more than pronouncing a series of words. He was unable to look ahead of his voice and therefore had no means of grasping the meaning of a sentence in more than word units. This was a very extreme case which should doubtless receive special treatment.

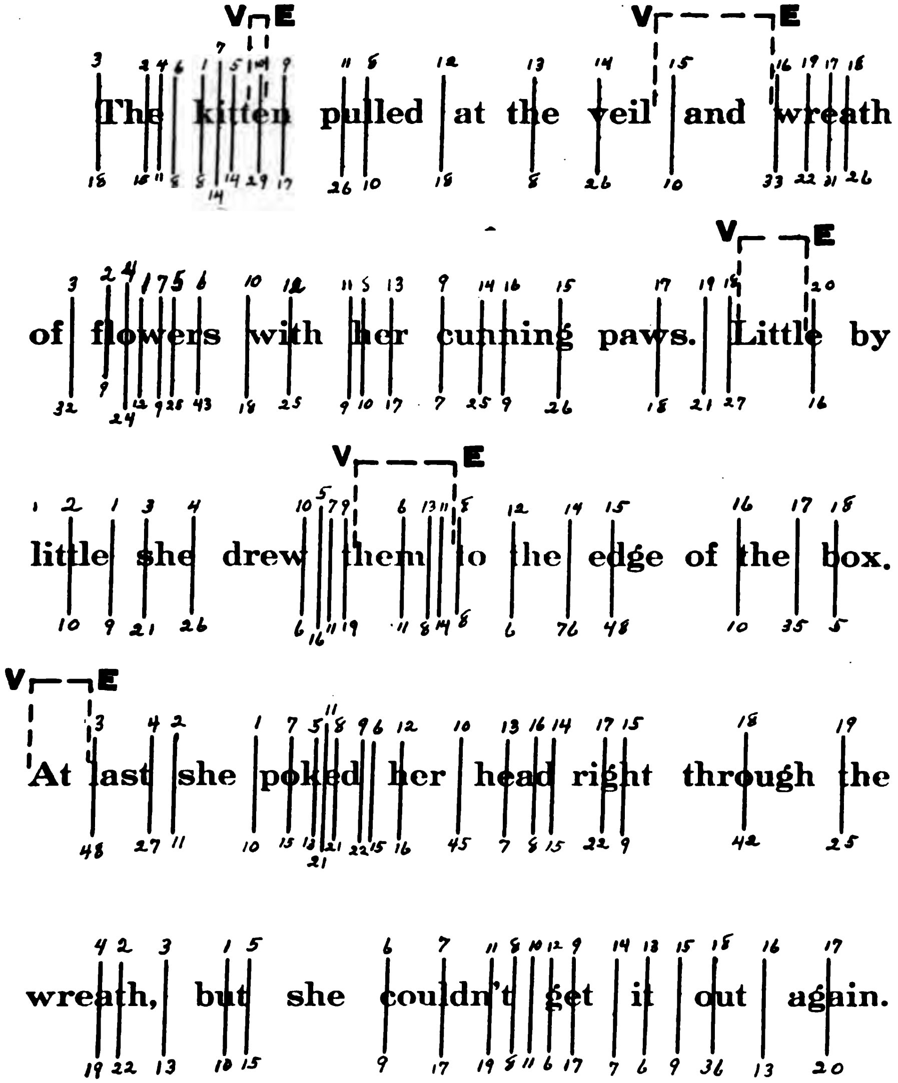
Plates VII and VIII show the records of a good and a poor reader from the third grade. The good reader, Subject E6, has an average span of 13.7 letter-spaces. In line 3 there was a large span of 20 letter-spaces. Subject E7, the poor reader, was a very active and talkative boy when not engaged in reading. He read as if the whole process were a bore to him and gave clear evidence that he did not hold the ability to read well in very high esteem. He had a very difficult time stumbling through the first line, making 29 fixations in the process. His average

PLATE V


The kitten pulled at the veil and wreath
of flowers with her cunning paws. Little by
little she drew them to the edge of the box.
At last she poked her head right through the
wreath, but she couldn't get it out again.
V
E

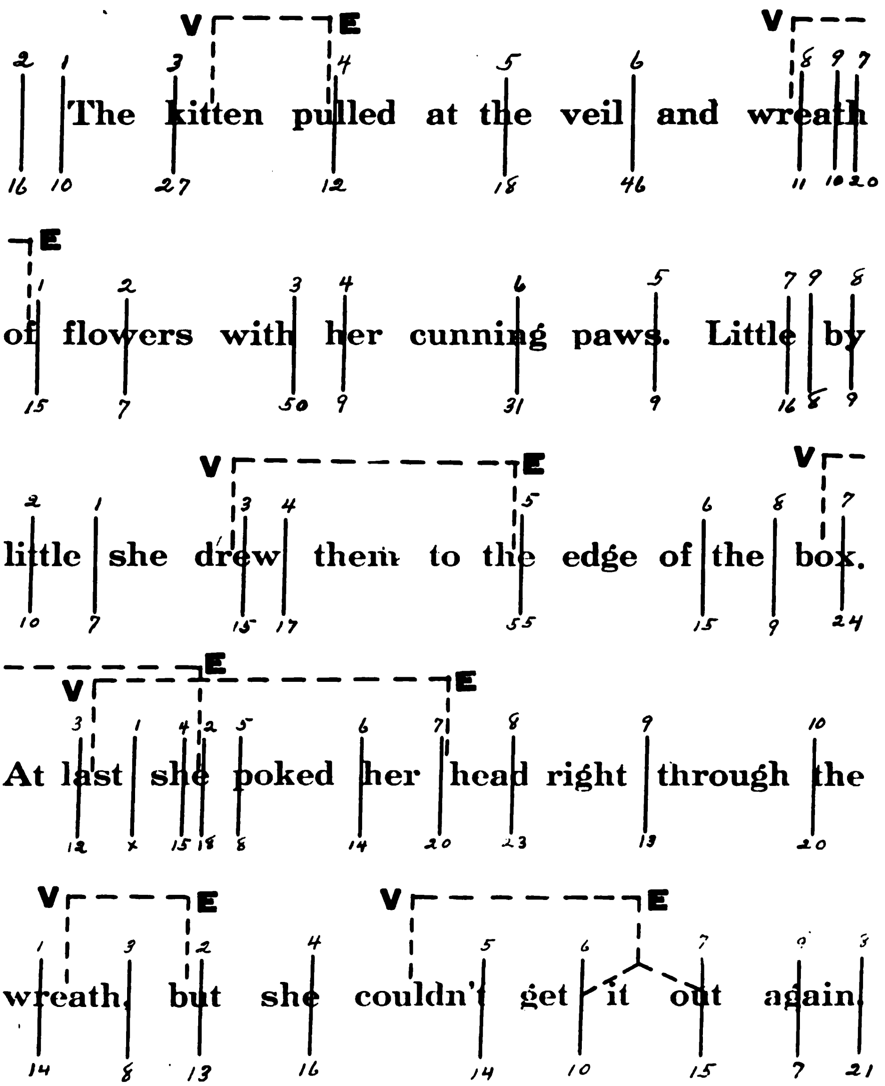
Eye-voice span of Subject E2, good reader, Grade II

PLATE VI


V E
The kitten pulled at the veil and wreath
of flowers with her cunning paws. Little by
little she drew them to the edge of the box.
At last she poked her head right through the
wreath, but she couldn't get it out again.

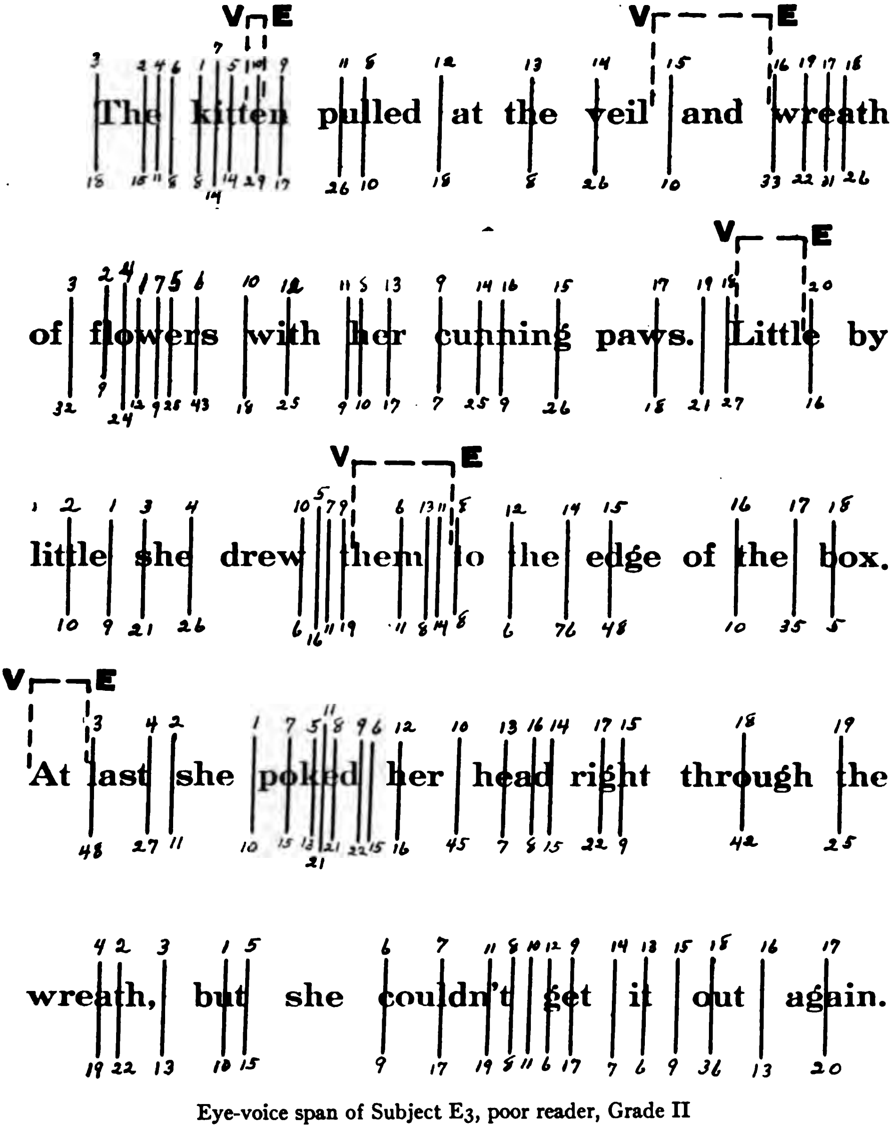
Eye-voice span of Subject E3, poor reader, Grade II

PLATE V


V E
The kitten pulled at the veil and wreath
of flowers with her cunning paws. Little by
little she drew them to the edge of the box.
At last she poked her head right through the
wreath, but she couldn't get it out again.

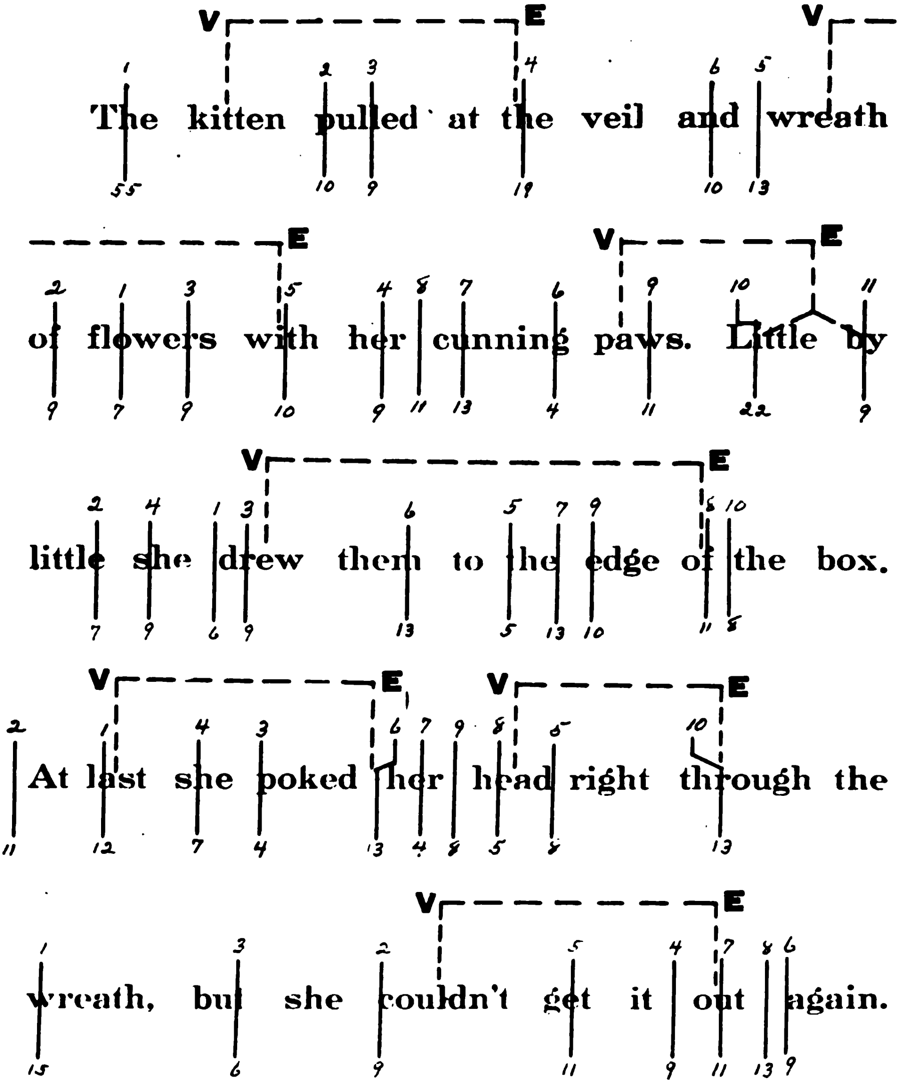
Eye-voice span of Subject E2, good reader, Grade II

PLATE VI


V E
The kitten pulled at the veil and wreath
of flowers with her cunning paws. Little by
little she drew them to the edge of the box.
At last she poked her head right through the
wreath, but she couldn't get it out again.

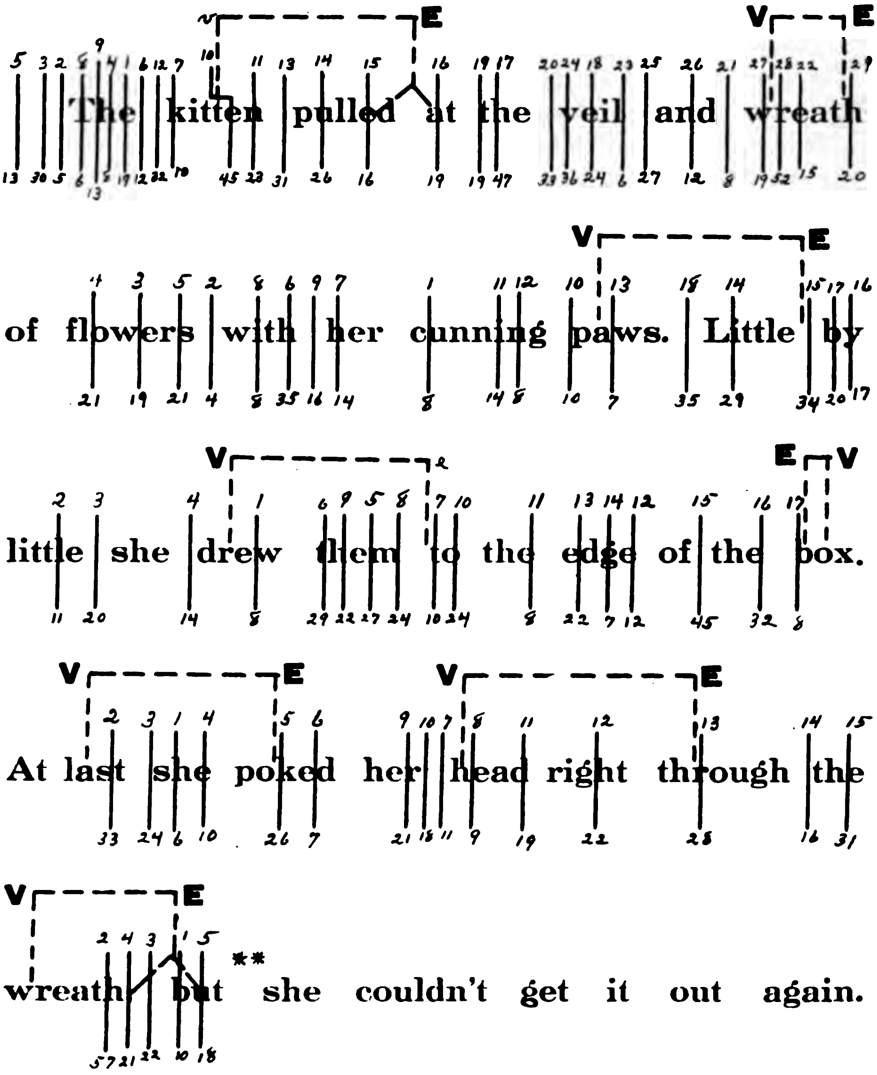
Eye-voice span of Subject E3, poor reader, Grade II

PLATE VII


V E
The kitten pulled at the veil and wreath
of flowers with her cunning paws. Little by
little she drew them to the edge of the box.
At last she poked her head right through the
wreath, but she couldn't get it out again.

Eye-voice span of Subject E6, good reader, Grade III

PLATE VIII


The kitten pulled at the veil and wreath
of flowers with her cunning paws. Little by
little she drew them to the edge of the box.
At last she poked her head right through the
wreath but she couldn't get it out again.
V
E
**

Eye-voice span of Subject E7, poor reader, Grade III. (**—end of film) eye-voice span was 8 letter-spaces. On the word "box" in the third line his span was reduced to zero.

Plate IX shows the record of a good reader in the fourth grade. That of the poor reader from this grade was given in Plate III. The good reader, Subject E9, had an eye-voice span of 11.1 letter-spaces. His record shows a distinct difference in the length of the span at the ends of the first two sentences, on the words "paws" and "box." These relatively shorter spans on the last word of a sentence are much more noticeable with a good reader than with a poor one.

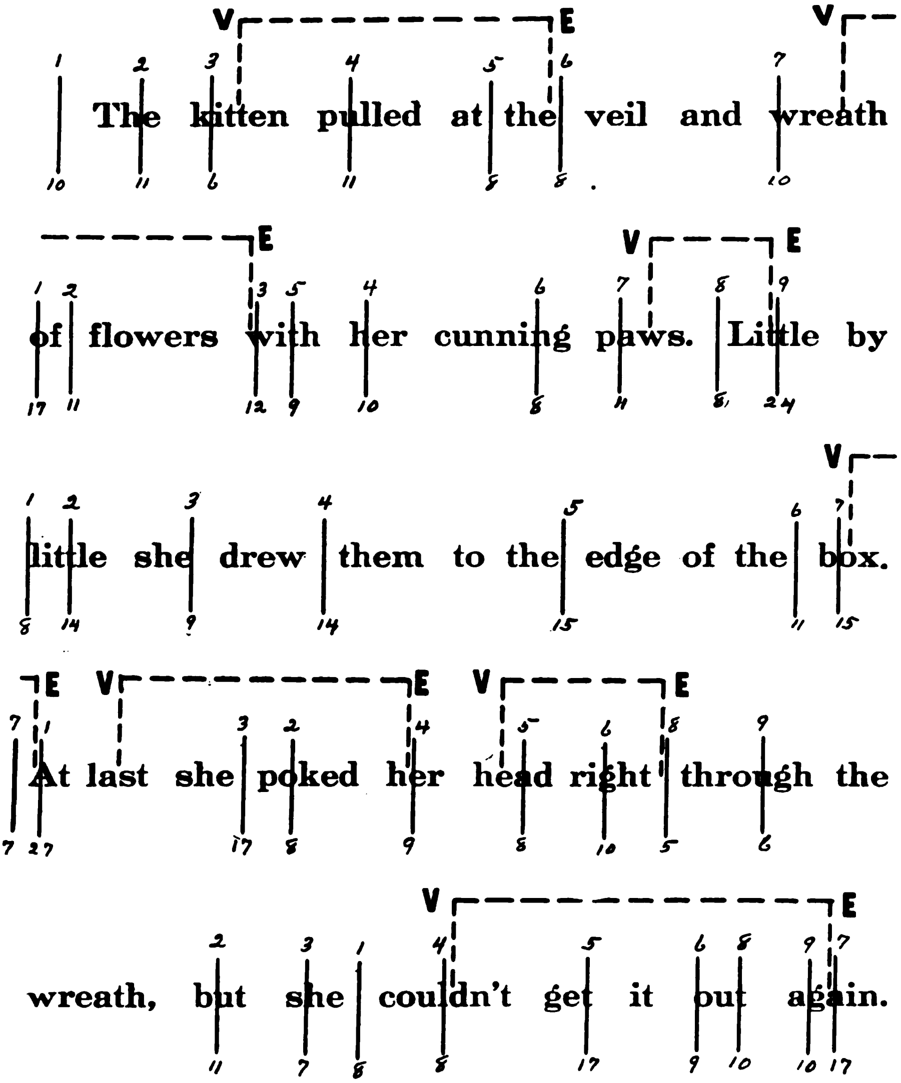
Plate X shows the record of a good reader from the fifth grade, who has an exceptionally wide eye-voice span which averages 19.7 letter-spaces. When this subject was pronouncing the word "head" in the fourth line, the eye was fixated just after the word "wreath" in the last line, making a span of 26 letter-spaces. Such a wide eye-voice span gives the reader a large opportunity to anticipate and interpret the meaning of the sentence in large units, and allows a much more expressive oral presentation than could be given without such a wide span.

Plate XI shows the record of a poor reader from this same grade, with an average span of only 7 letter-spaces. A comparison of these two records will readily show the handicap under which a person with a short span reads.

Plates XIV and XV show the wide variation in the reading of two seventh-grade pupils. Subject E22, in Plate XIV, has an average eye-voice span of 19.7 letter-spaces. The second fixation in the last line of this plate shows a type of eye-movement which occurs frequently in the reading of all subjects. It will be noticed that the first fixation falls upon the first word of the line, while the second appears to fall just before the last word. A careful examination of the film shows that an upward movement of the eye was made between fixations 1 and 2 and that the eye was really refixated upon the latter part of the preceding line.

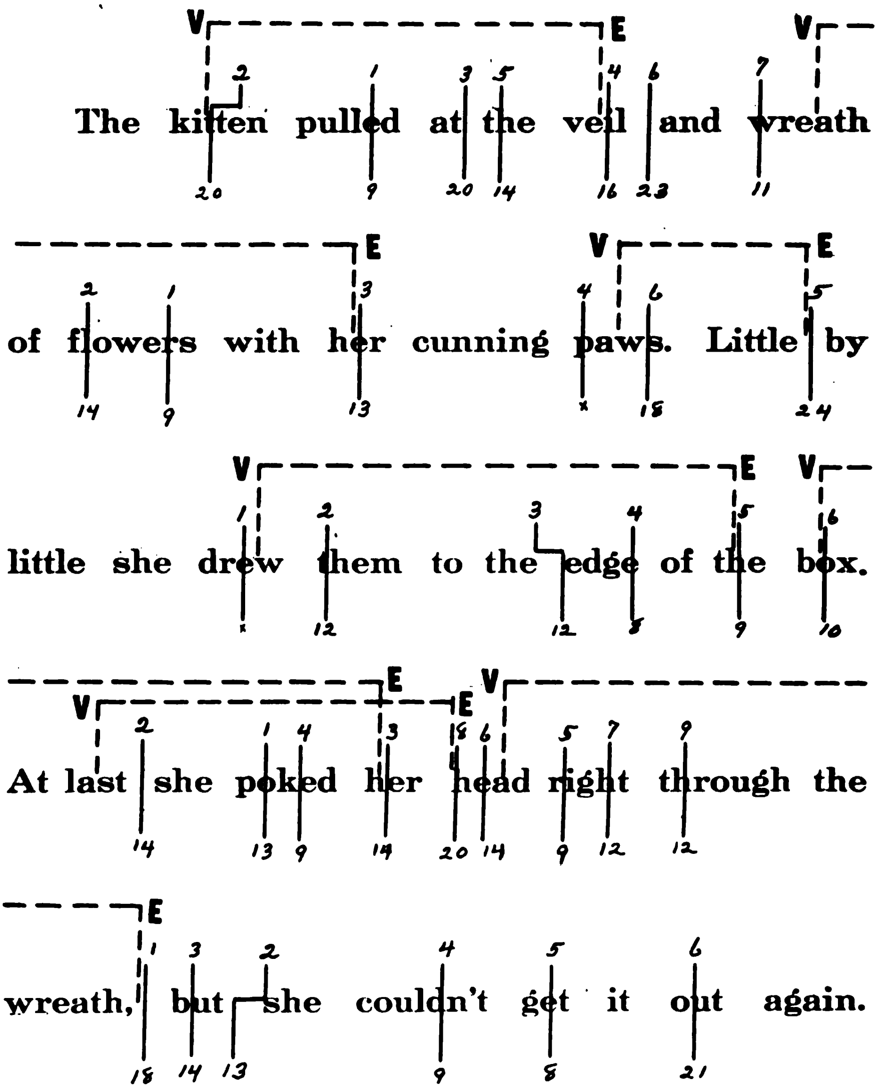
Since the film passed through the camera in the vertical plane, the vertical movements of the eye would not appear directly. The method of determining an upward movement of the eye in this case needs further explanation. The film passed through the camera in a downward direction. A horizontal eye movement from the end of one line to the beginning of the next would appear as an oblique line, due to the fact that the eye moves *down* to the next line while the film is also moving in the same direction. If the eye moved from one end of a line to the other end of the same line, the degree of obliqueness would be less

PLATE IX


1 2 3 4 5 6 7
The kitten pulled at the veil and wreath
10 11 6 11 9 8 10
1 2 3 5 4 6 7 8 9
of flowers with her cunning paws. Little by
17 11 12 9 10 8 11 8, 24
1 2 3 4 5 6 7
little she drew them to the edge of the box.
8 14 9 14 15 11 15
7 1 3 2 4 5 6 8 9
At last she poked her head right through the
7 27 17 8 9 8 10 5 6
2 3 1 4 5 6 8 9 7
wreath, but she couldn't get it out again.
11 7 8 8 17 9 10 10 17
V
E

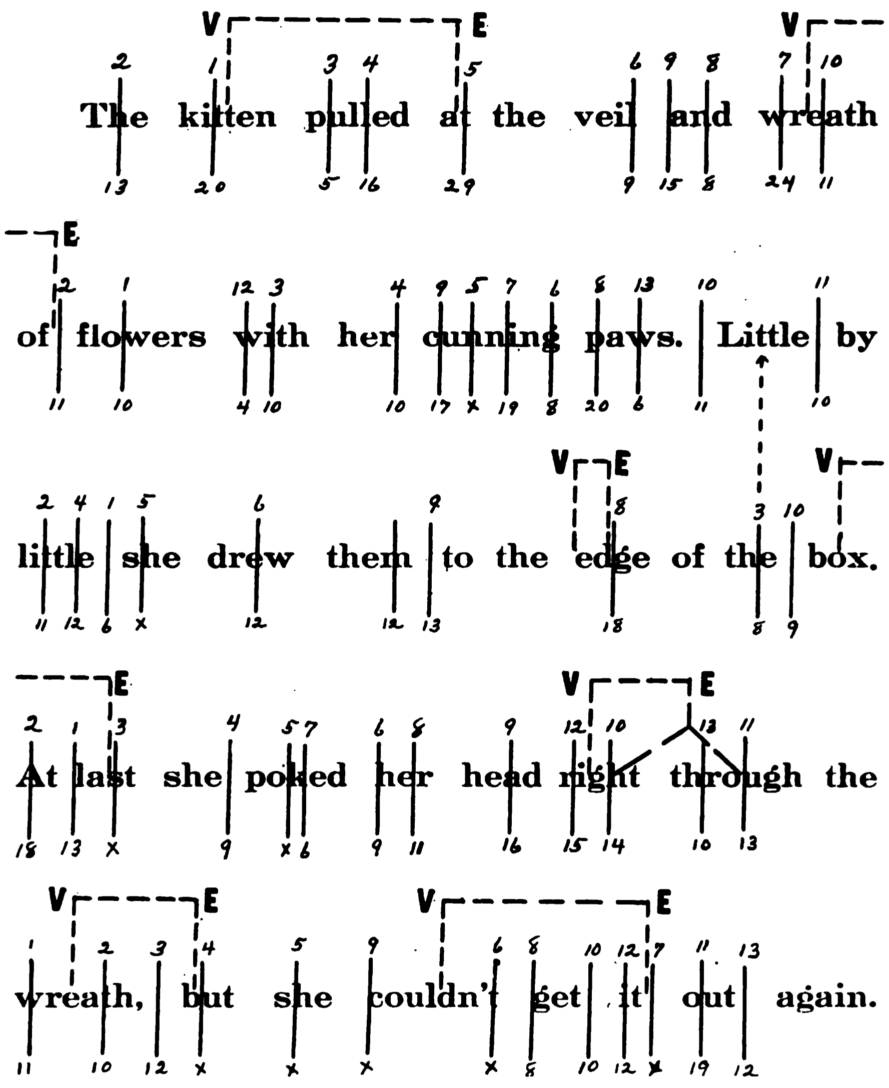
Eye-voice span of Subject E9, good reader, Grade IV

PLATE X


The kitten pulled at the veil and wreath
of flowers with her cunning paws. Little by
little she drew them to the edge of the box.
At last she poked her head right through the
wreath, but she couldn't get it out again.
V
E

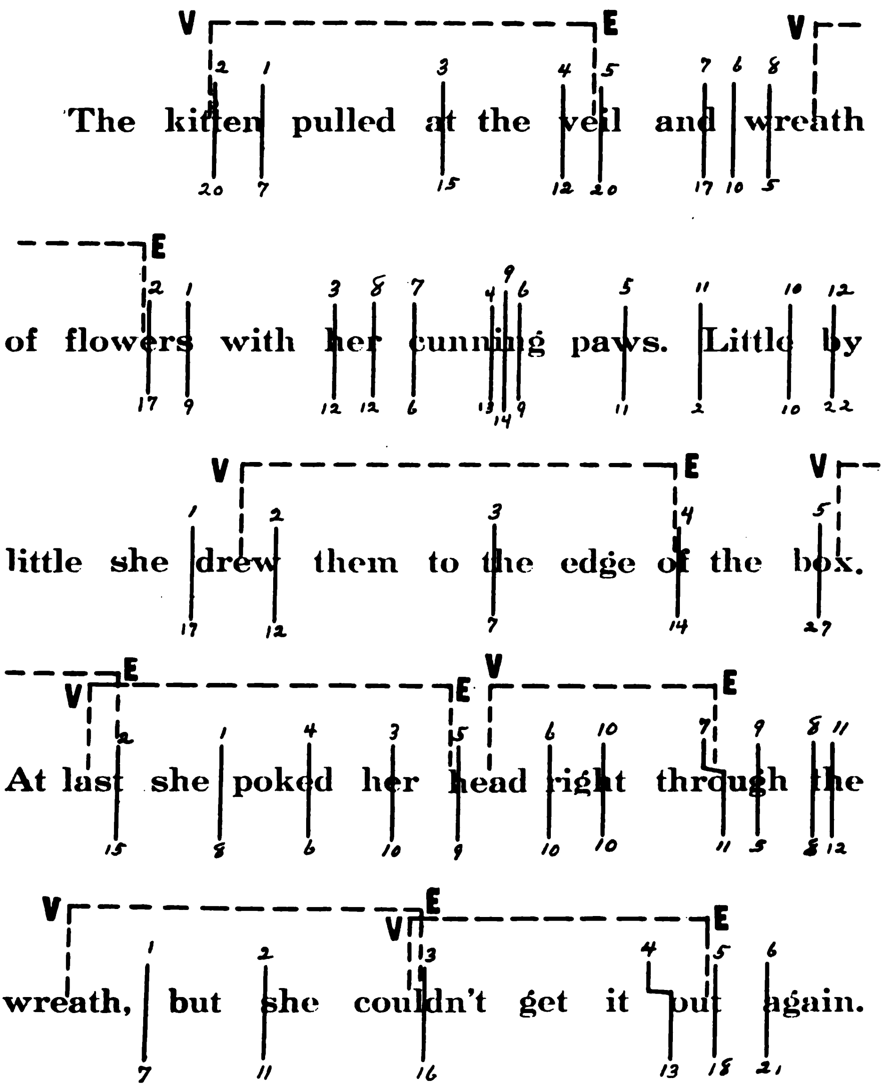
Eye-voice span of Subject E13, good reader, Grade V

PLATE XI


V E
The kitten pulled at the veil and wreath
of flowers with her cunning paws. Little by
little she drew them to the edge of the box.
At last she poked her head right through the
wreath, but she couldn't get it out again.

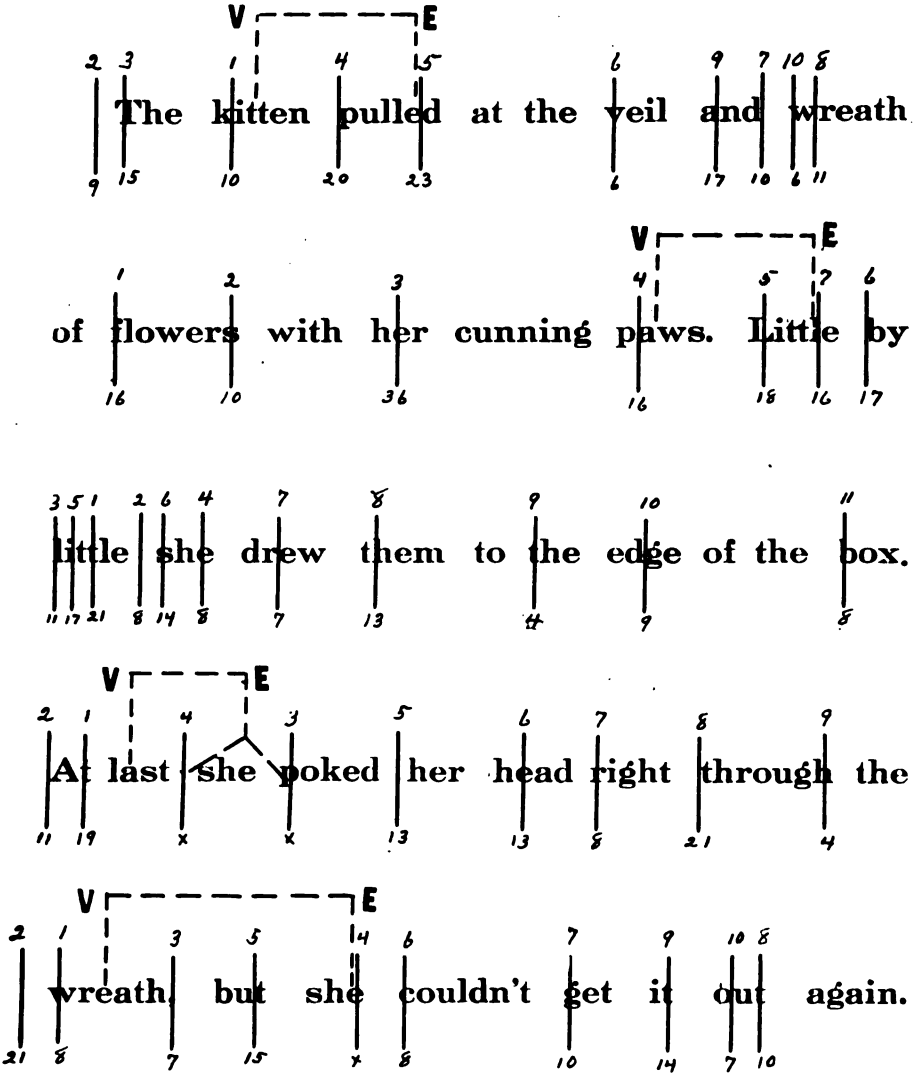
Eye-voice span of Subject E16, poor reader, Grade V. The mark x in this and following plates indicates that it was impossible to determine with precision the length of the fixation.

PLATE XII


V
E
The kitten pulled at the veil and wreath
of flowers with her cunning paws. Little by
little she drew them to the edge of the box.
At last she poked her head right through the
wreath, but she couldn't get it out again.

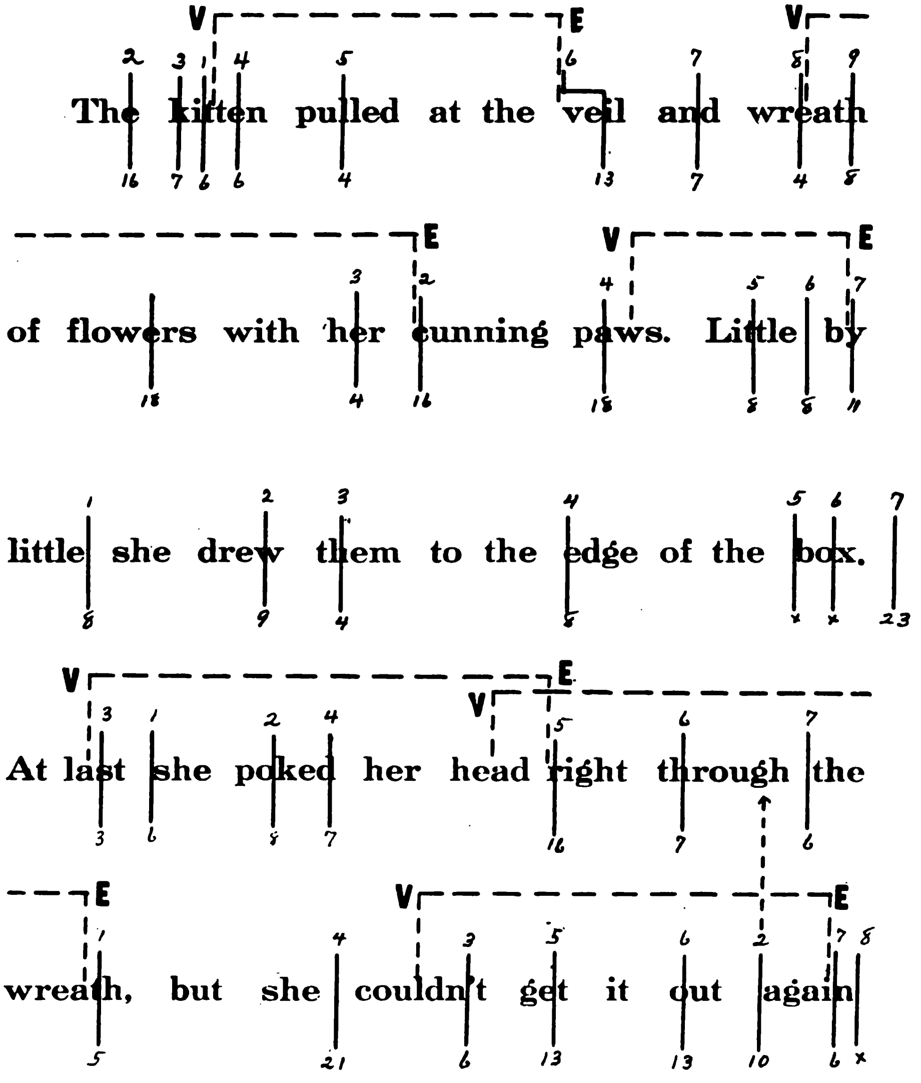
Eye-voice span of Subject E17, good reader, Grade VI

PLATE XIII


V
E
The kitten pulled at the veil and wreath
of flowers with her cunning paws. Little by
little she drew them to the edge of the box.
At last she poked her head right through the
wreath but she couldn't get it out again.

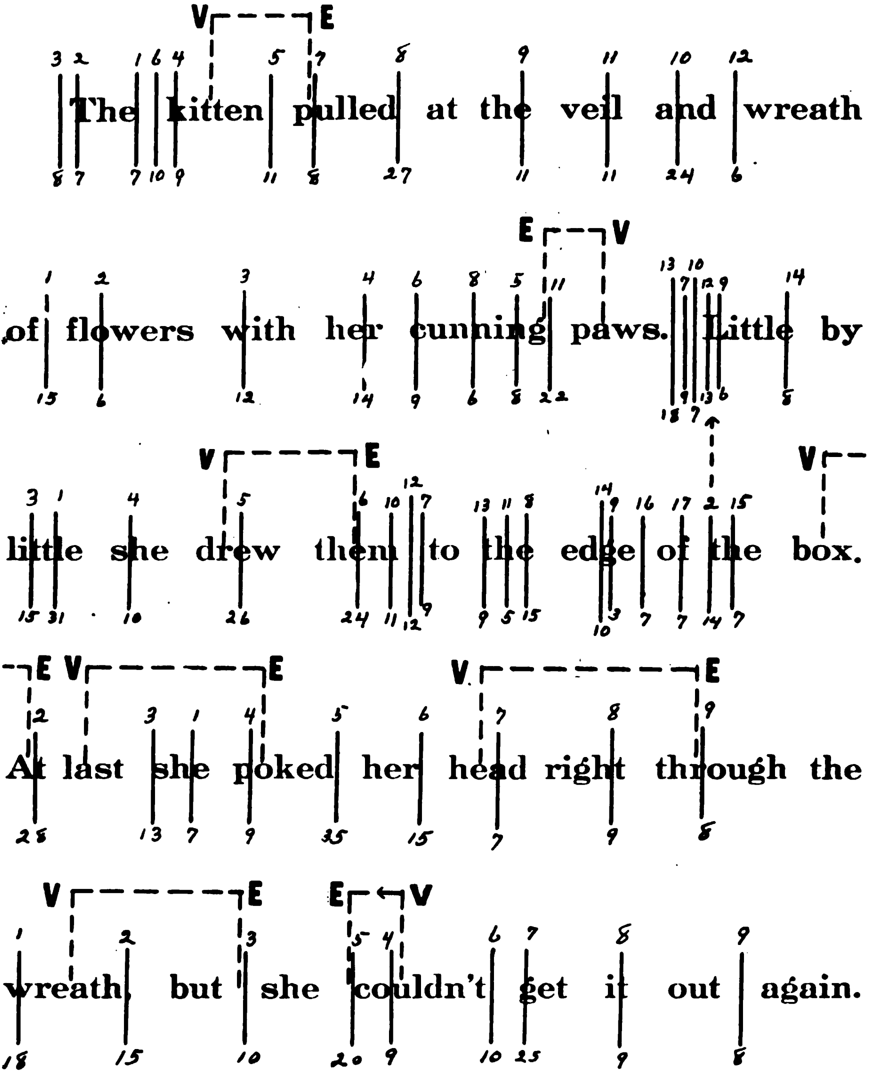
Eye-voice span of Subject E19, poor reader, Grade VI

PLATE XIV


The kitten pulled at the veil and wreath
of flowers with her cunning paws. Little by
little she drew them to the edge of the box.
At last she poked her head right through the
wreath, but she couldn't get it out again
V
E

Eye-voice span of Subject E22, good reader, Grade VII

PLATE XV


The kitten pulled at the veil and wreath
of flowers with her cunning paws. Little by
little she drew them to the edge of the box.
At last she poked her head right through the
wreath, but she couldn't get it out again.
V
E

Eye-voice span of Subject E24, poor reader, Grade VII because there would be no added drop of the eye to the line below. The movement to the second fixation in the last line of Plate XIV not only failed to show an oblique in the downward direction, but it showed a slight oblique in the upward direction. The only possible explanation is that the eye was raised a little more than was necessary to overcome the downward movement of the film. A careful examination of the film shows that, when compared to the degree of slant of a movement of the eye across the same line, the upward movement in this case is approximately equal to the added downward movement when the eye makes its regular drop from line to line. This would locate the fixation following the upward oblique on the line above. This is indicated in the plates by a dotted line above the fixation point, showing that a regressive movement was actually made to the preceding line, although it appears at first glance to be a long movement in the forward direction.

A similar regressive movement is seen in the second fixation of line 3 in Plate XV. Such fixations are sufficiently frequent to indicate that the transition from line to line presents a difficulty to some readers.

Subject E24, in Plate XV, was an exceedingly poor reader for the seventh grade. In lines 2 and 5 his record shows the curious situation of having the eye behind the voice. In both cases this is due to a regressive movement which occurred as the measure was taken. The reading of this subject was poorer than that of the two better readers in the second grade and his eye-voice span was also narrower.

The average eye-voice span for the twenty-four high-school subjects is given in Table III. The same facts are expressed graphically in Figure 2. Here again the greater width of the span for the good readers is made clear. In the freshman class the average eye-voice span of the good readers was greater by 37 per cent, in the sophomore class by 16 per cent, in the junior class by 74 per cent, and in the senior class by 28 per cent. For the total group of high-school subjects the average span of the good readers exceeds that of the poor readers by 36 per cent. This evidence is in agreement with that from the elementary-school pupils, and clearly shows a high degree of correlation between good reading and a wide eye-voice span.

The consistent development in the width of the eye-voice span through the high-school grades is not so evident as in the lower grades. The good readers from the freshman class have a wider span than those from the sophomore and junior classes, and one practically equal to that of the senior class. The average span for the poor readers from the junior class is lower than that of any of the other three. These differences may be accounted for by the fact that in high school little attention is given to reading as a special subject of instruction above the freshman year. The freshman class had been undergoing a series of experimental training exercises conducted by the English department.

TABLE III

AVERAGE EYE-VOICE SPAN BY GRADES—HIGH-SCHOOL SUBJECTS*

SUBJECTS	GRADE				AVERAGE FOR ALL GRADES
	Freshman	Sophomore	Junior	Senior	
Good readers	15.8	14.5	14.6	15.9	15.2
Poor readers	11.5	12.5	8.2	12.4	11.2
Good and poor....	13.7	13.5	11.4	14.2	13.2

* Data for lines 5 and 6 not included.

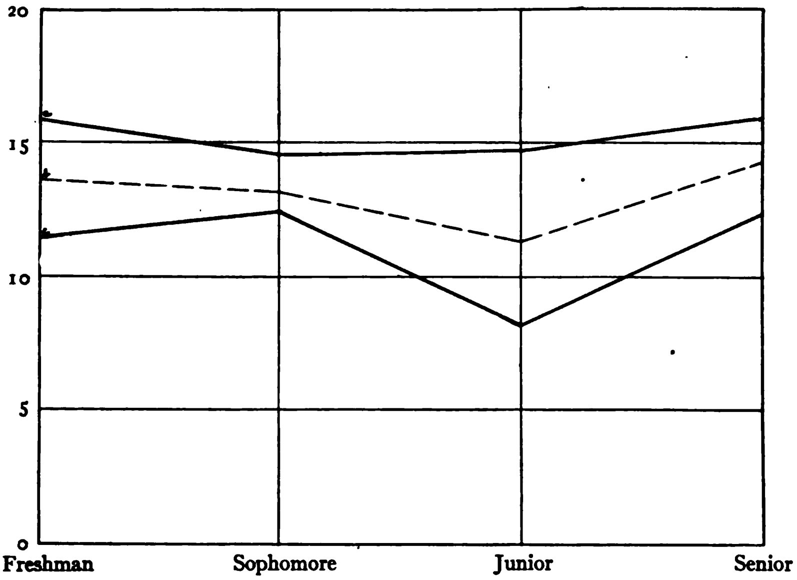


FIG. 2.—Average eye-voice span by grades—high-school subjects

This special training probably accounts for the superiority of the pupils in this class.

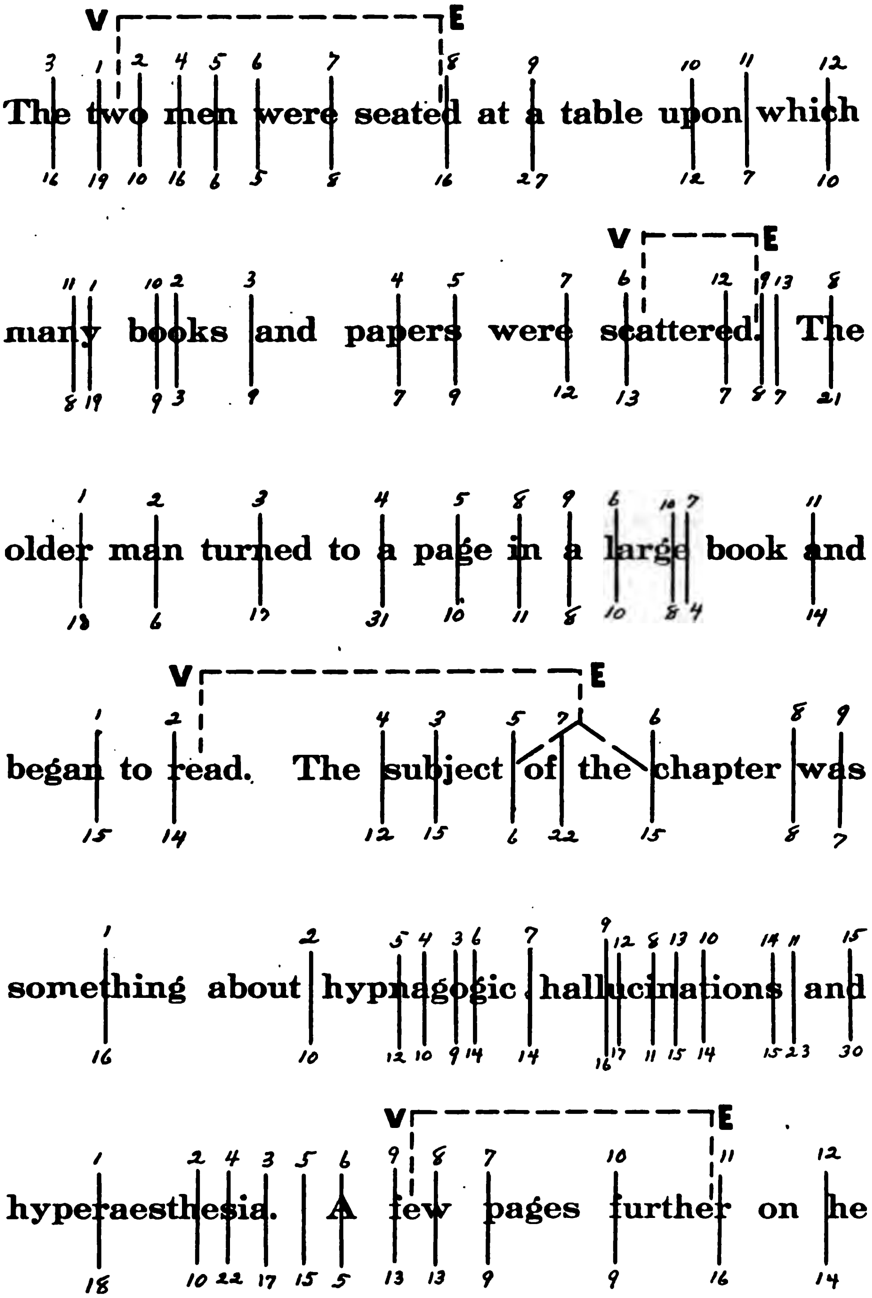
Plates IV and XVI–XX show representative readings of high-school subjects. The record of a good reader from the freshman class, with an average span of 14.3 letter-spaces, is given in Plate IV. The span for this subject is quite regular, showing little variation in any of the eight positions measured. Plate XVI gives the record for a poor reader from the same grade. The average eye-voice span for this reader is 12.4 letter-spaces. The last half of the record for a good reader from the junior class is shown in Plate XVII. This subject had an average span of 17.7 letter-spaces. The ease with which he read the sentence in quotations shows that if the words are simple, it is unnecessary to understand the thought in order to read in a normal fashion. This subject certainly had no idea of the way "the original elements of our consciousness grew up," and yet he read the sentence in the same manner in which he read the first four easy lines. A record of a poor reader from the junior class is given in Plate XVIII. The width of the average span for this subject is only 8.5 letter-spaces, and shows considerable variation throughout the selection. Plates XIX and XX show the records of a good and a poor reader from the senior class having little difference in the average width of their eye-voice span.

On the whole there was less difference in the width of span between the good and poor readers in the high school than in the elementary grades. This is to be expected, since even a poor high-school reader does fairly well. The poorest readers of the elementary school are probably eliminated and never reach high school.

The group of six college students had a development of the eye-voice span beyond that of the high-school group. The average span for the good adult readers is 18.9 letter-spaces, for the poor readers 11.7 letter-spaces, and for the group as a whole 15.3 letter-spaces. The difference between the good and poor readers is again very large.

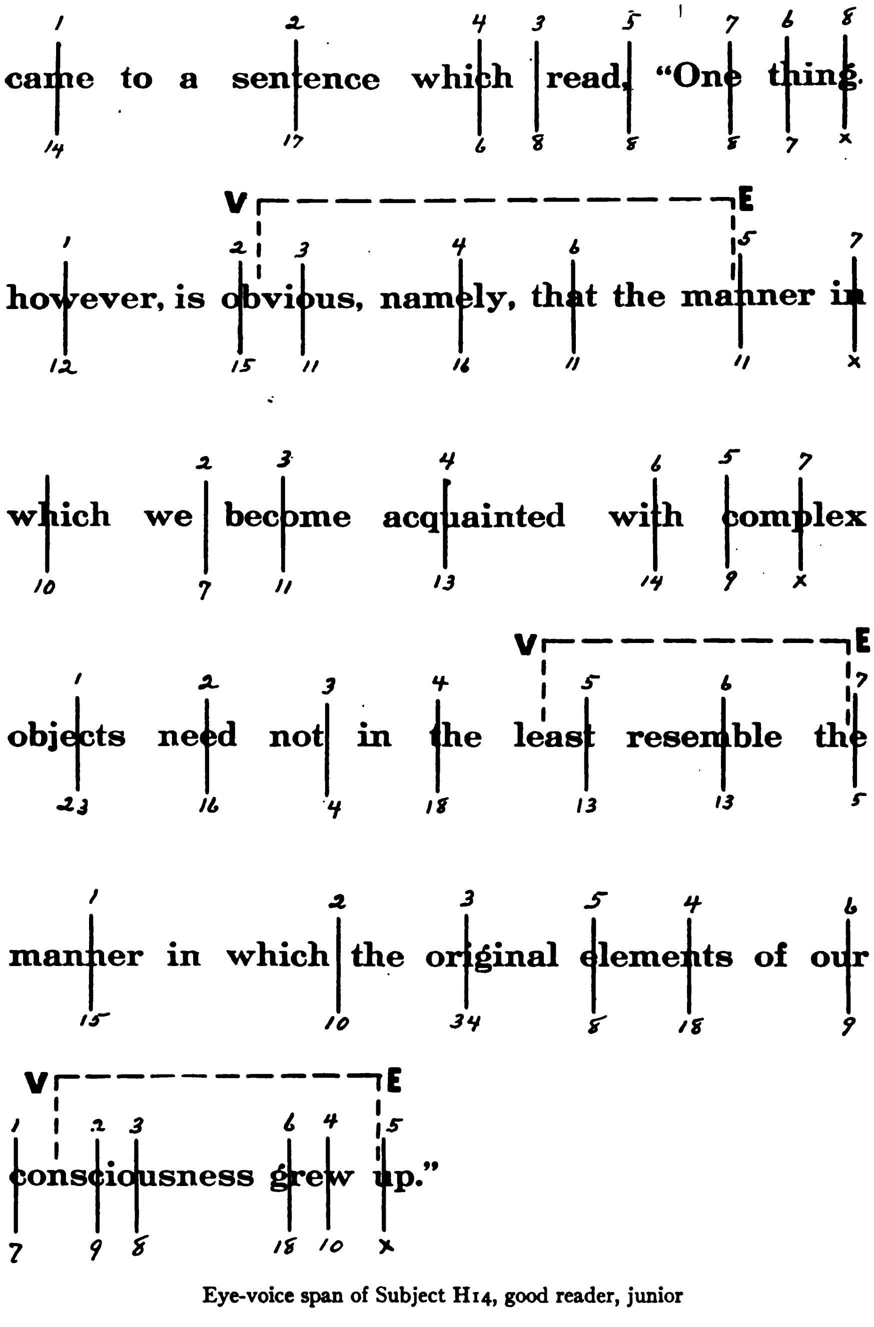
The development of the eye-voice span for the entire fifty-four subjects is shown in Figure 3. The upper solid line represents the twenty-seven good readers, the lower solid line the twenty-seven poor readers, and the middle broken line the good and poor readers taken together. Following the line for the good readers it will be noticed that the greatest rise in the curve occurs during the second, third, and fourth grades. The average span of the good readers in the fifth grade is wider than that of any other grade. The average span for the fifth-, sixth-, and seventh-grade good readers is 14.9 letter-spaces, while the average for the entire high-school group of good readers is only 15.2. Remembering that the average for the sixth grade is abnormally low, owing to the exceptional variation of a single subject, the results seem to indicate that the eye-voice span should be well developed by the end of the fourth grade. They show positively that it is possible for a fifth-grade

PLATE XVI


V
E
The two men were seated at a table upon which
many books and papers were scattered. The
older man turned to a page in a large book and
began to read. The subject of the chapter was
something about hypnagogic hallucinations and
hyperaesthesia. A few pages further on he

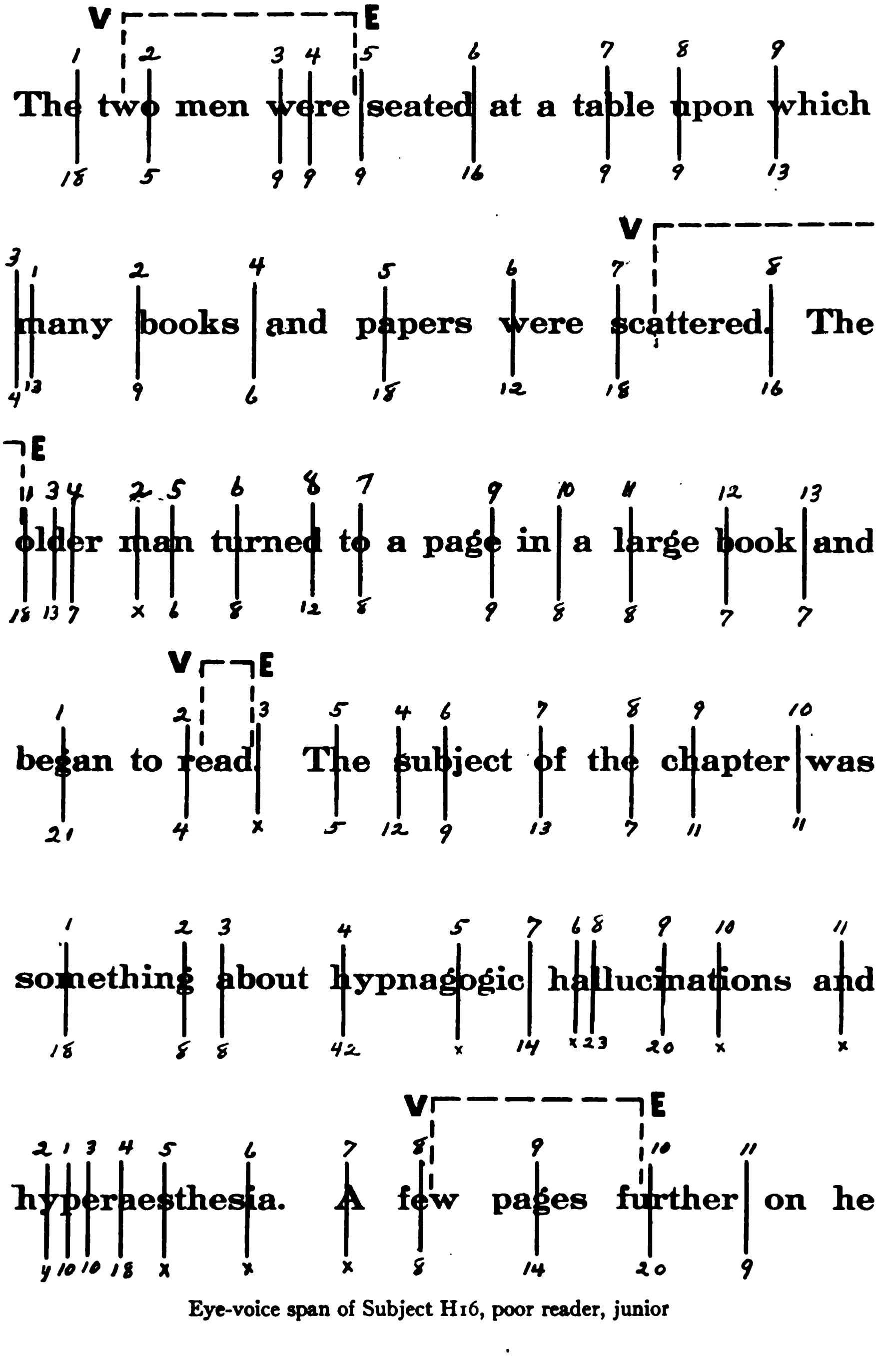
Eye-voice span of Subject H6, poor reader, freshman

PLATE XVII


came to a sentence which read, "One thing,
however, is obvious, namely, that the manner in
which we become acquainted with complex
objects need not in the least resemble the
manner in which the original elements of our
consciousness grew up."
V
E

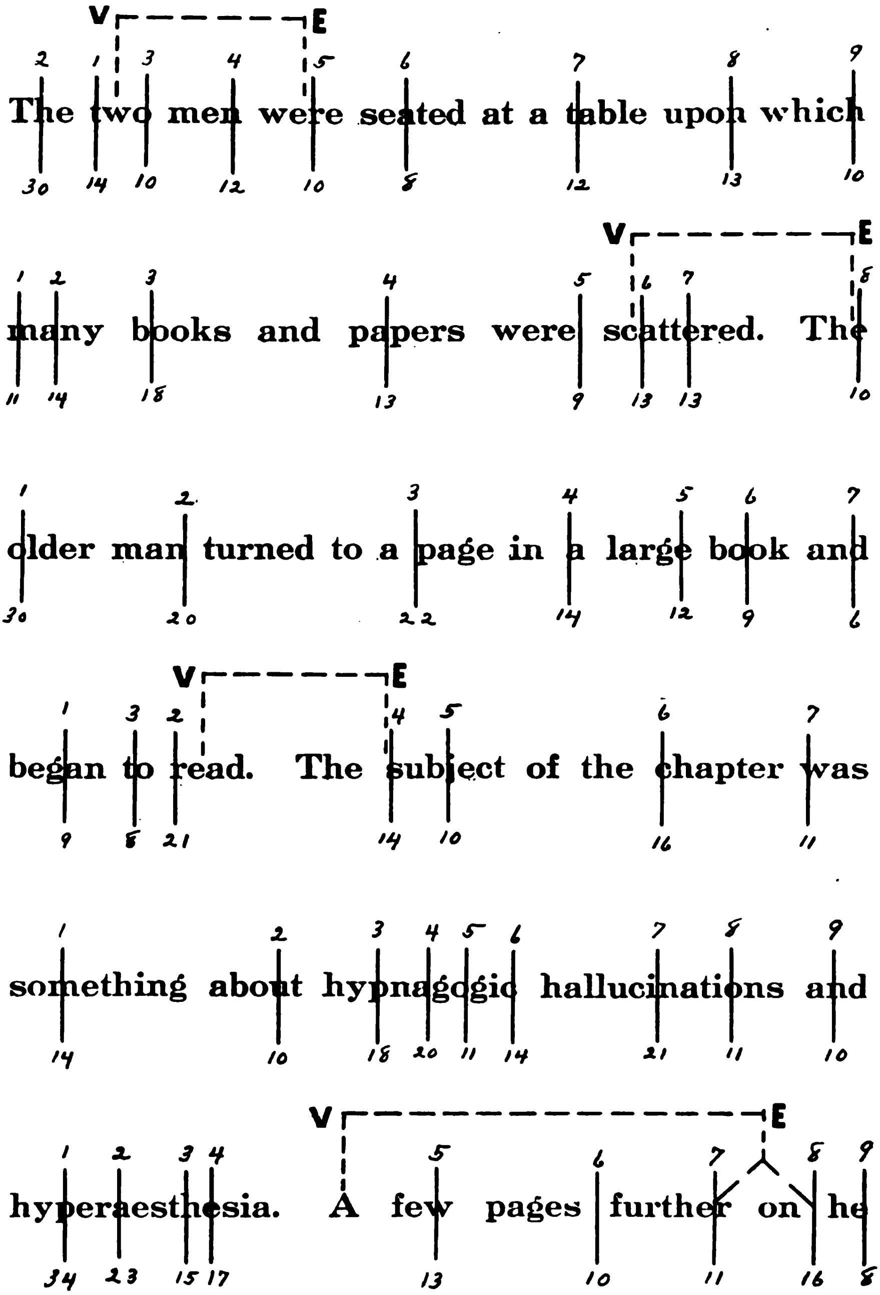
Eye-voice span of Subject H14, good reader, junior

PLATE XVIII


The two men were seated at a table upon which
many books and papers were scattered. The
older man turned to a page in a large book and
began to read. The subject of the chapter was
something about hypnagogic hallucinations and
hyperaesthesia. A few pages further on he
V
E

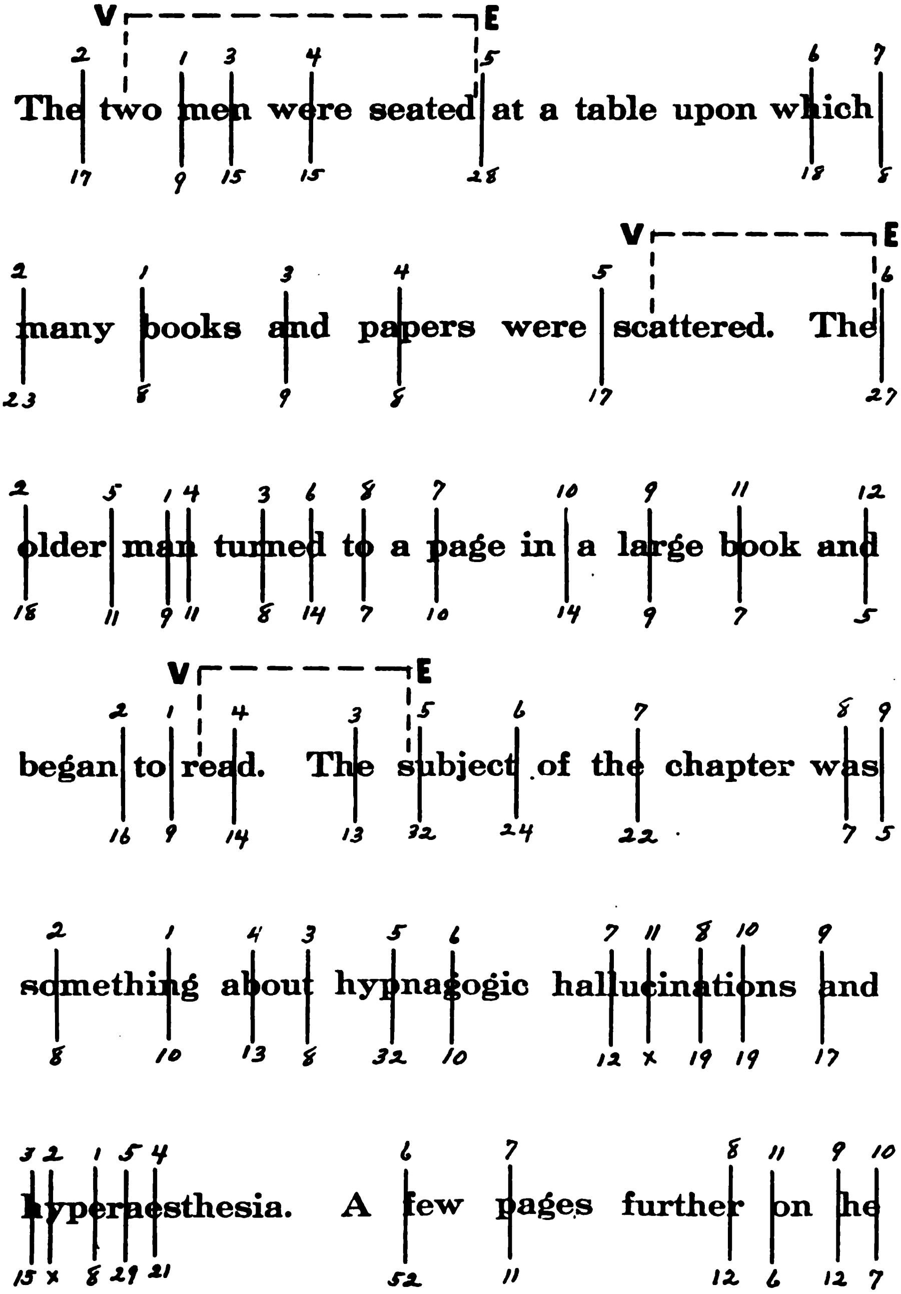
Eye-voice span of Subject H16, poor reader, junior

PLATE XIX


V E
2 1 3 4 5 6 7 8 9
The two men were seated at a table upon which
30 14 10 12 10 8 12 13 10
V E
1 2 3 4 5 6 7 8
many books and papers were scattered. The
11 14 18 13 9 13 13 10
1 2 3 4 5 6 7
older man turned to a page in a large book and
30 20 22 14 12 9 6
V E
1 3 2 4 5 6 7
began to read. The subject of the chapter was
9 8 21 14 10 16 11
1 2 3 4 5 6 7 8 9
something about hypnagogic hallucinations and
14 10 18 20 11 14 21 11 10
V E
1 2 3 4 5 6 7 8 9
hyperaesthesia. A few pages further on he
34 23 15 17 13 10 11 16 8

Eye-voice span of Subject H19, good reader, senior

PLATE XX



The two men were seated at a table upon which many books and papers were scattered. The older man turned to a page in a large book and began to read. The subject of the chapter was something about hypnagogic hallucinations and hyperaesthesia. A few pages further on he

Eye-voice span of Subject H24, poor reader, senior

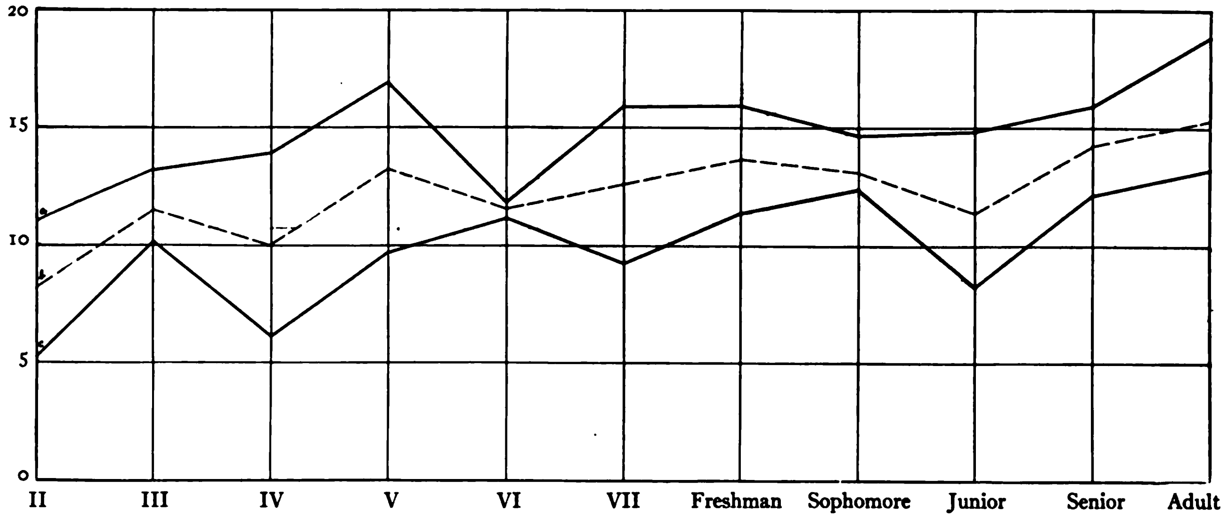


FIG. 3.—Development of eye-voice span—all subjects. Upper line—good readers. Lower line—poor readers. Middle line—both good and poor readers.

reader to maintain an average eye-voice span as wide as the average for any of the school grades above that year. Since the correlation of a wide span with good reading is so clearly shown, it would seem very desirable to give definite training for a wider span in the grades below the fifth.

The line for the poor readers shows on the whole a gradual rise from the second grade to the end of high school. Variations occur in places, but if the curve were smoothed a general rise would appear.

The upward rise of the line for the good readers for the first four grades would indicate a possibility of reaching a maximum eye-voice span during those years, provided specific devices of method for increasing the span could be constructed and applied. The other lines of the curve indicate that at present this is not being accomplished for most of the pupils, but that the span develops gradually throughout the whole school period. This increased emphasis upon the eye-voice span during the first four years would seem to be justified for two reasons. The first is that a wide span is a significant factor in oral reading and these are the years in which the oral method is employed. The second is because, as will be shown more fully in chapter iv, the eye-voice span in oral reading is closely related to the recognition of meaning in silent reading, and whatever benefit might be derived from a wide span in oral reading should be made available for silent reading by the end of the fourth grade.

Regardless of the amount of development through the grades, Figure 3 shows unmistakably that for all grades the good readers have a much wider span than the poor readers. There must be something about a wide eye-voice span which is characteristic of mature reading, and the converse must be true for the narrow span. This matter of the eye-voice span must not be confused with the perception-span. The eye sometimes leads the voice by a distance of several perception-spans. The value of a wide eye-voice span apparently lies in the fact that it allows the mind to grasp and interpret a large meaning unit before the voice must express it.

Relation of eye-voice span to position in sentence.—If the width of the eye-voice span of a single subject is measured at several positions in a selection, it will be found to show considerable variation from point to point. C. T. Gray observed this fact in his study but did not attempt to analyze the variations or explain them. In Quantz's study, referred to in the introduction, these variations were also noted, and an explanation proposed in terms of the position of the line. Quantz found an average eye-voice span of 7.4 words at the beginning of a line, 5.1 words in the middle, and 3.8 words at the end of a line. The results of the present study do not agree with those of Quantz. For the fifty-four subjects used, the width of the span at the beginning of the line is 12.7 letter-spaces, in the middle of the line 12.7, and at the end of the line 10.9. The only point of agreement is that the span is slightly narrower at the end of the line than in other positions. Since an analysis of the variations by position in the line does not afford an adequate explanation as to the reason for the variation, it must be concluded that there are other complicating factors. Accordingly, two factors which might complicate the situation were selected for further analysis. The fact that there is a large difference in the width of the span for the good and the poor readers suggested the possibility that quality of reading might be related in some way to the variation in width of span within a selection. Also, the fact that oral reading is modified according to the units of thought expressed suggested that position in the sentence might be a more potent factor than position in the line. Accordingly, a detailed analysis was made of the variation in the width of the eye-voice span by the position in the sentence for the good and poor readers separately, and then for all subjects taken together.

By referring to Plates III and IV, it will be seen that in the selection used, the eye-voice span was measured in positions at the beginning, middle, and end of the sentences. In the elementary-school selection, the positions where the span was measured were on the following words: (1) "kitten," (2) "wreath," (3) "paws," (4) "drew," (5) "box," (6) "last," (7) "head," (8) "wreath," (9) "couldn't." For the high-school selection the positions were on these words: (1) "two," (2) "scattered," (3) "read," (4) "few," (5) "obvious," (6) "complex," (7) "least," (8) "consciousness." In Tables IV and V and in Figures 4 and 5, the horizontal series of numbers refer to the positions in the selections in the same serial order as just given. By looking again at Plate III it will be found that for the elementary-school selection positions numbered 1 and 6 occurred at the beginning of sentences, positions 2, 4, 7, 8, and 9 fell within sentences, and positions 3 and 5 occurred at the end of sentences. For the high-school selections, Plate IV, positions 1 and 4 occurred at the beginning, positions 5, 6, and 7 within, and positions 2, 3, and 8 at the end of sentences.

Table IV gives the eye-voice span at each of the positions for the elementary-school subjects. It should be read as follows: Subject E1, a good reader from the second grade, had an eye-voice span of 18 letter-spaces at the first position, which was at the word "kitten" in the selection. At the second position, which was at the word "wreath," his span was 13 letter-spaces, etc. His average span was 11.8 letter-spaces, while the average variation among the positions was 2.5 letter-spaces. The second half of the table gives the data for the poor readers. The averages for each position are given for both good and poor readers. Figure 4 shows a comparison of these averages graphically, for both good and poor readers. The numbers on the horizontal axis refer to the number of the positions in the selection, while the letters *B*, *W*, and *E* are abbreviations for beginning, within, and end of a sentence. The figures on the vertical axis represent the width of the span in letter-spaces. The upper line is that of the good, and the lower line is that of the poor readers. Lines *b* and *d*, respectively, give the averages of the good and the poor readers for all positions.

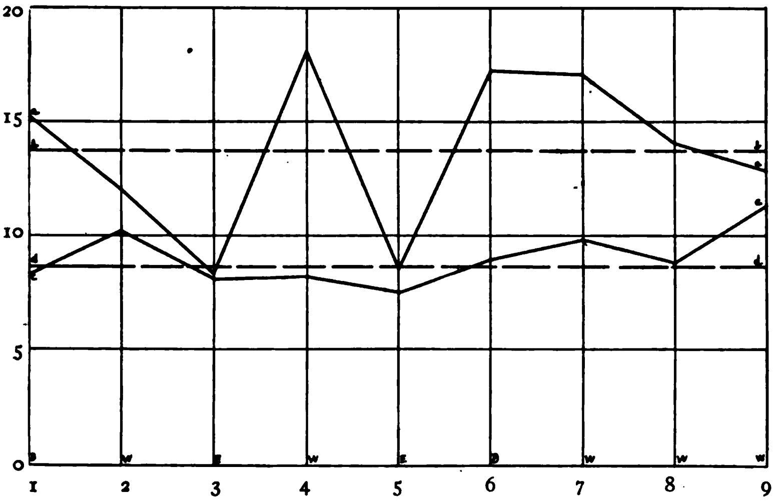


FIG. 4.—Average eye-voice span by position in sentence—elementary subjects. Position at beginning (B), within (W), and end (E) of sentence shown on horizontal axis. Width of eye-voice span shown on vertical axis.

The most noticeable deviations in the line *a*, for the good readers, occurred at positions numbers 3 and 5. These are the only positions occurring at the end of sentences. The shortening of the eye-voice span here is relatively very great, and is entirely too pronounced to be accidental. The good readers have evidently found that, for the sake of emphasis, a considerable pause must be made at the end of sentences. The time during the pause gives the eye ample opportunity to get ahead and consequently, on the last word before the pause, the eye-voice span is reduced. The relative shortening of the span on the last word of a sentence would therefore indicate an appreciation of the meaning and an attempt to convey it by expressing, through the pause, the fact that a unit of thought had been given. An examination of the record of the poor readers does not indicate any considerable variation in the length of the span at these points. Evidently the eye has travelled right along, the voice has ignored the ending of a unit of thought and has kept its regular distance behind the eye.

TABLE IV

AVERAGE EYE-VOICE SPAN BY POSITION IN SENTENCE—ELEMENTARY SUBJECTS

SUBJECT	GRADE	EYE-VOICE SPAN AT POSITIONS IN PARAGRAPH									AVERAGE	AVERAGE VARIATION
		1	2	3	4	5	6	7	8	9		
		Good Readers										
E1	II	18	13	11	.....	.....	.....	9	8	12	11.8	2.5
E2	II	6	5	.....	13	13	17	.....	6	12	10.3	3.9
E5	III	14	8	12	12	7	19	16	14	12	12.7	2.8
E6	III	15	15	10	20	.....	11	11	.....	14	13.7	2.6
E9	IV	17	13	6	.....	2	14	8	.....	18	11.1	5.0
E10	IV	19	8	2	28	10	25	20	21	.....	16.6	7.5
E13	V	20	20	11	23	21	17	26	.....	.....	19.7	3.3
E14	V	11	.....	9	11	.....	17	24	18	7	13.9	5.0
E17	VI	20	10	.....	21	7	17	12	18	14	14.9	4.1
E18	VI	10	5	2	19	5	.....	.....	13	8	8.9	4.4
E21	VII	.....	.....	8	16	3	13	20	.....	12	12.0	4.3
E22	VII	17	23	12	.....	.....	22	24	.....	20	19.7	3.4
Average		15.2	12.0	8.3	18.1	8.5	17.2	17.0	14.0	12.9	13.8	2.9
Average Variation		3.6	4.8	3.0	4.5	4.6	2.8	5.8	4.3	2.9	2.7	....
		Poor Readers										
E3	II	1	4	5	4	.....	3	.....	.....	.....	3.4	1.1
E4	II	13	.....	12	3	4	.....	.....	5	.....	7.4	4.1
E7	III	10	5	11	8	1	9	13	7	.....	8.0	2.8
E8	III	10	20	10	5	18	13	13	9	15	12.6	3.6
E11	IV	6	3	6	2	2	4	.....	.....	5	4.0	1.4
E12	IV	11	8	9	15	6	6	3	8	8	8.2	2.3
E15	V	9	.....	7	26	7	13	10	10	17	12.4	4.8
E16	V	11	6	2	.....	8	.....	5	6	11	7.0	2.6
E19	VI	8	.....	8	.....	.....	5	.....	11	.....	8.0	1.5
E20	VI	12	20	.....	.....	12	.....	13	15	.....	14.4	2.5
E23	VII	3	17	12	6	13	20	.....	8	12	11.4	4.2
E24	VII	5	.....	.....	6	4	8	12	9	.....	7.3	2.3
Average		8.2	10.3	8.2	8.3	7.5	9.0	9.8	8.8	11.3	8.7	0.9
Average Variation		3.0	6.4	2.6	5.4	3.2	4.2	3.3	2.0	3.3	2.7	....

A second point of difference between the good and the poor readers is shown by Figure 4 at those positions falling at the beginning of sentences. Positions numbered 1 and 6 show the width of the eye-voice span at the beginning of two sentences. The line for the good readers shows a wider span than the average, at these points, while that of the poor readers varies from the general average by only a very small amount. This gives evidence that when a good reader begins the reading of a new thought, he allows the eye to proceed for a considerable distance before starting to read. This wide initial span gives him an intelligent grasp of the nature of the selection before beginning to read, and enables him to show a proper interpretation through his oral expression. The line for the poor readers shows that the initial span is no wider than the average. This would prevent the reader from obtaining a longer look ahead which is particularly helpful at the beginning of a sentence.

The line for the poor readers differs from that of the good in that it has only a small variation for all positions. For the poor reader, oral reading is evidently a monotonous process of passing over words without any great attempt to emphasize what is read. The good reader varies his span at different positions in the selection in order to bring about a better emphasis. This is shown in Table IV by the difference in the average variation of the averages for all positions. For the good readers the average variation of the averages is 2.9 letter-spaces, while for the poor readers the average variation is 0.9 letter-spaces. The study indicates, therefore, that for elementary-school pupils a variation in the width of the span for different positions is a characteristic of good reading more than of poor reading, and that for good readers the span is wider at the beginning of a sentence, a little narrower within a sentence, and much narrower at the end of a sentence. The poor readers show less variation and exhibit a tendency to commence reading as soon as the material is put before them, having a narrower span at the beginning than at those positions within the sentence. These data are very suggestive of a causal relationship between width of eye-voice span and the interpretation of meaning as exhibited by the treatment of a sentence as a unit of thought and the modification of the eye-voice span to fit such a unit.

The data showing the variation of the span by position in the sentence for the high-school subjects are given in Table V, and are expressed graphically in Figure 5. In general, the results are comparable with those of the elementary subjects. For the high-school selection, positions numbered 2, 3, and 8 occur at the end of sentences. The line for good readers shows a considerable drop in the eye-voice span at these points, while the drop for the poor readers is less marked. The positions at the beginning of sentences are numbers 1 and 4. Here both the good and the poor readers show a span which is wider than the average. The poor readers from the elementary school had a narrower span at the beginning of sentences. Evidently by the time pupils have reached the high school they have learned that a wider span at these positions is desirable and have inhibited the tendency to begin to read as soon as the selection is put before them. The poor readers from the high school look ahead enough to get an idea of the sentence before starting to read. This would be expected, since even a poor reader in the high school reads fairly well, while a poor reader in the elementary school is still in the process of learning to read. The line for the poor readers is more uniform than that of the good readers,

TABLE V

AVERAGE EYE-VOICE SPAN BY POSITION IN SENTENCE—HIGH-SCHOOL SUBJECTS

SUBJECT	GRADE	EYE-VOICE SPAN AT POSITIONS IN PARAGRAPH								AVERAGE	AVERAGE VARIATION
		1	2	3	4	5	6	7	8		
		Good Readers									
H1	F	14	18	13	16	25	20	32	21	19.9	4.6
H2	F	14	15	13	12	12	15	15	18	14.3	1.5
H3	F	......	13	......	12	15	......	......	......	13.3	1.1
H7	So	......	......	21	16	......	6	11	6	12.0	5.2
H8	So	26	11	10	17	13	8	23	16	15.5	5.0
H9	So	23	14	11	......	......	......	......	......	16.0	4.7
H13	J	......	10	14	......	......	18	20	7	13.8	2.9
H14	J	22	17	10	......	26	......	15	16	17.7	4.2
H15	J	11	12	12	18	10	......	......	11	12.3	1.9
H19	Se	8	11	8	20	10	14	17	14	12.8	3.5
H20	Se	30	16	......	......	......	......	......	......	23.0	7.0
H21	Se	7	16	13	......	......	......	......	......	12.0	3.3
Average		17.2	13.9	12.5	15.9	15.9	13.5	19.0	13.6	15.2	1.8
Average Variation		7.1	2.3	2.3	2.2	5.5	4.3	5.1	4.1	2.7	....
		Poor Readers									
H4	F	9	10	11	......	......	......	......	......	10.0	0.7
H5	F	14	11	9	10	10	14	13	15	12.0	2.0
H6	F	16	7	19	14	12	13	......	6	12.4	3.5
H10	So	......	14	14	16	24	6	12	13	14.1	3.3
H11	So	11	8	8	13	8	15	8	6	9.6	2.5
H12	So	18	15	15	15	12	9	13	13	13.8	2.0
H16	J	11	12	2	10	8	10	9	6	8.5	2.4
H17	J	3	5	3	......	10	5	......	2	4.7	2.0
H18	J	......	12	11	......	......	......	......	......	11.5	0.5
H22	Se	15	9	22	18	9	15	9	14	13.9	3.6
H23	Se	13	9	10	10	9	13	11	11	10.8	1.3
H24	Se	17	11	9	......	......	10	......	15	12.4	2.9
Average		12.7	10.3	11.1	13.3	11.3	11.0	10.7	10.1	11.2	0.8
Average Variation		3.3	2.3	4.3	2.5	3.1	3.0	1.7	4.0	1.9	....

as was the case with the elementary subjects. Uniformity for the different positions, however, is evidently an indication that the sentence as a unit of thought is being ignored and that the eye and voice travel along with little regard for the separation of thought into different sentences.

A summary comparison of the eye-voice span at the different positions in the sentence is given in Table VI, for all subjects. Figure 6 presents these same results graphically. The summaries were compiled by grouping together all positions occurring at the beginning of sentences in one group, those occurring within the sentence in another, and those falling at the end of a sentence in a third group. The table shows the results of this grouping for the elementary, high-school, and adult subjects separately, and also for all fifty-four subjects together. In each table the results for the good and the poor readers are separated.

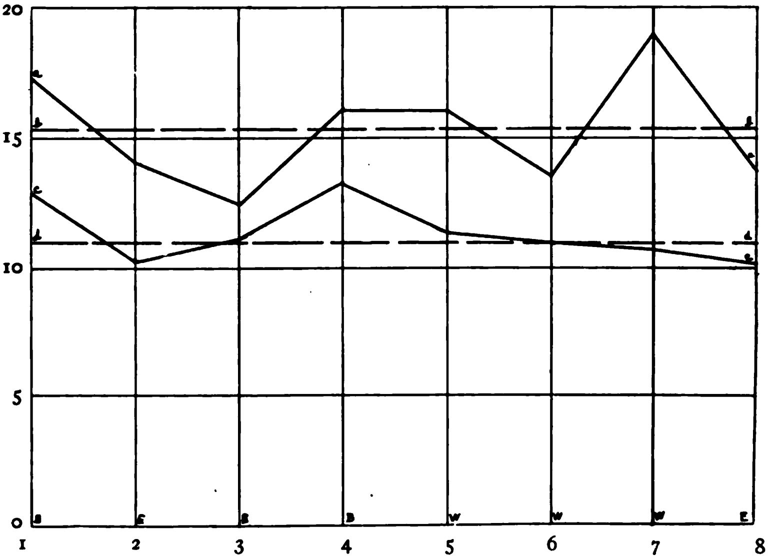


FIG. 5.—Average eye-voice span by position in sentence—high-school subjects

An examination of these data reveals two conspicuous facts: first, that the width of the eye-voice span is different at various positions in a sentence, and secondly, that the good and poor readers do not exhibit these differences in the same fashion.

The results of the investigation show that for the entire group of fifty-four subjects the eye-voice span is 15.9 letter-spaces at the beginning of a sentence, 13.4 spaces within the sentence, and 10.9 spaces at the end. The differences are even more marked in the group of twenty-seven good readers. For this group the average span at the beginning of a sentence is 18.7 letter-spaces, within the sentence 16.5 spaces, and at the end 11.9 spaces. The average span for the good readers at the beginning is greater than the average span within the sentence by 13 per cent and greater than the average at the end of the sentence by 57 per cent. For the poor readers the span at the beginning is greater than the span at the end in all three groups of subjects, and is greater than the span within the sentence for all but the elementary pupils. The evidence is quite conclusive, therefore, that the width of the eye-voice span varies according to the position in the sentence.

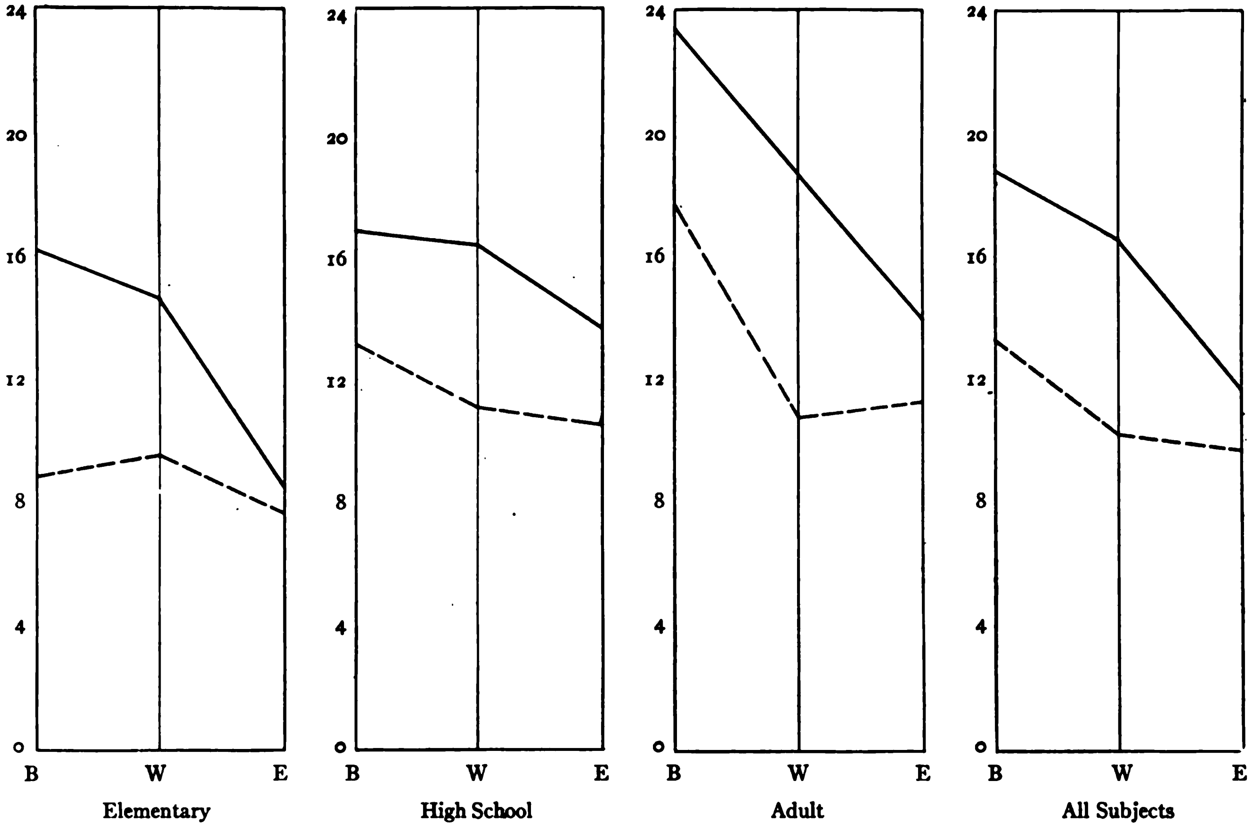
TABLE VI

AVERAGE EYE-VOICE SPAN AT THE BEGINNING, WITHIN, AND AT THE END OF SENTENCE—ALL SUBJECTS

Subjects	Beginning of Sentence	Within Sentence	End of Sentence
Elementary subjects:			
Good readers	16.1	14.8	8.4
Poor readers	8.6	9.5	7.9
Good and poor	12.3	12.1	8.1
High-school subjects:			
Good readers	16.6	16.2	13.3
Poor readers	12.9	11.0	10.5
Good and poor	14.7	13.6	11.9
Adult subjects:			
Good readers	23.5	18.6	14.0
Poor readers	17.7	10.8	11.3
Good and poor	20.6	14.7	12.6
All subjects:			
Good readers	18.7	16.5	11.9
Poor readers	13.1	10.4	9.9
Good and poor	15.9	13.4	10.9

The characteristics of the variations of the eye-voice span at different positions in the sentence are not the same for good and poor readers. The curve for the good readers shows more regard for thought units, with the highest point always at the beginning and the lowest point always at the end of the sentence. The gross change in the width of the span for the different positions also is greater for the good readers.

The fact that the eye-voice span varies with the position in the sentence is of considerable significance. If the span varied only with



Elementary

High School

Adult

All Subjects

FIG. 6.—Average eye-voice span at the beginning (B), within (W), and at the end (E) of sentence—all subjects. Solid line represents good readers. Broken line represents poor readers.

the position in the line, as Quantz's study indicated, the determining factors would be entirely mechanical, and would be governed by the printed form of the selection. The control of the span, in that case, would be a matter of the mechanics of book construction, and would be independent of any teaching factor. But if the span varies with the position in the sentence, it is evident that the content of the meaning is recognized, and that the eye-voice span is determined by thought units rather than by printed line units. Position in the line may be a minor factor, as the results of this study showed a slightly narrower span at the end of a line, but the differences due to position in the sentence are much greater.

For all three classes of subjects, there is agreement among the good readers in that a wide eye-voice span occurs at the beginning of a sentence. The situation at the beginning of a sentence is different from that of any other position. After one has started to read, the meaning of the thought covered will carry him along to some extent, and will enable him to anticipate what is coming. At the beginning of a sentence there is no sequence of words to give one the cue to the content of the new thought. The only way to get this is to look ahead until the meaning of the sentence is partially recognized, and the kind of vocal expression needed is made clear. The good readers recognize this need for a wider span at the outset and inhibit the voice reaction until the eye has gained a considerable lead. The poor readers in the grades above the elementary school have also learned this, but evidently those in the elementary school are not mature enough in reading to recognize any special difficulty at the beginning of a sentence. Instead of making a relatively longer span, they react to the situation by a relatively shorter one. They begin to read as soon as they see the sentence, and have not learned to inhibit their reading until the eye has taken in a larger unit of meaning. This difficulty could be easily corrected by a little training in class which would teach the pupils to wait before starting to read until they get a larger unit of thought.

The evidence of all subjects agrees that there is a shorter span at the end of a sentence. The good readers have a relatively shorter span than the poor readers. The explanation of this shorter span goes back again to the fact that the sentence is the large unit of meaning. When the eye reaches the end of this unit it modifies its movements according to the meaning recognized and the voice catches up before beginning the new thought. In order that the voice shall express the thought clearly, a pause is necessary at the end of the sentence. This pause gives the eye ample opportunity for a large eye-voice span before it is time to commence the next sentence. A poor reader pays less attention to the sentence as a unit of meaning. This is especially true of younger children who are very immature readers. For them the whole process is a more or less monotonous repetition of words as they are encountered. The eye moves along at a regular rate and the voice follows. The end of a sentence creates no special disturbance for it is passed over with little attention. Consequently there is little change in the eye-voice span. The curve for the poor readers from the elementary school would seem to indicate that some such situation exists. There is little variation in the width of the span for any position in the sentence. If the variation in eye-voice span at the beginning and the end of a sentence makes possible a greater emphasis on meaning, the lack of such a variation may account for the fact that the subjects showing such lack are classed as poor readers.

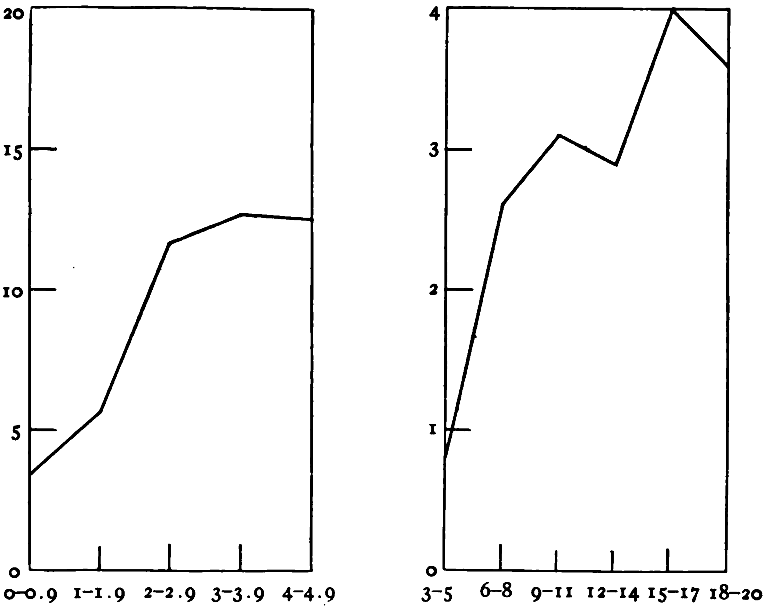
Relation of eye-voice span to reading rate.—In the previous sections of this chapter it has been shown that a wide eye-voice span correlates with good reading and also with certain positions in the sentence. Since numerous studies have shown a correlation between quality and rate of reading, it would be of interest to find if the eye-voice span is related to rate in the same way. Accordingly, a study was made of the relation of eye-voice span to reading rate for the subjects in the elementary school, the high school, and for the entire group of subjects taken together. The reading rate of each subject was taken with the same material at the time of the experiment. Comparisons are given both in terms of rate per second and the average eye-voice span. The data for the elementary school are given in Table VII, for the high school in Table VIII, and for all subjects taken together in Table IX. The figures showing the same data are numbered to correspond with the tables.

Table VII gives the data for the elementary subjects and should be read as follows: Using rate per second as a base, it was found that one subject had a rate falling between 0 and 0.9 words per second and an eye-voice span of 3.4 letter-spaces, two subjects had rates falling between 1 and 1.9 words per second and an average eye-voice span of 5.7 letter-spaces, nine subjects had rates falling between 2 and 2.9 words per second and an average span of 11.6 spaces, etc. The second part of the table gives the data based upon eye-voice span instead of rate, and should be read: Two subjects had average spans of between 3 and 5 letter-spaces and an average rate of 0.8 words per second, six

TABLE VII

RELATION OF EYE-VOICE SPAN TO READING RATE—ELEMENTARY SUBJECTS

NUMBER OF SUBJECTS	RATE OF WORDS PER SECOND	AVERAGE EYE-VOICE SPAN
	By Rate	
1	0-0.9	3.4
2	1-1.9	5.7
9	2-2.9	11.6
9	3-3.9	12.6
3	4-4.9	12.5
	By Eye-Voice Span	
2	0.8	3-5
6	2.6	6-8
5	3.1	9-11
8	2.9	12-14
1	4.0	15-17
2	3.6	18-20



By rate

By eye-voice span

FIG. 7.—Relation of eye-voice span to reading rate—elementary subjects. By rate: words per second shown on horizontal axis; average eye-voice span on vertical axis. By eye-voice span: words per second shown on vertical axis; average eye-voice span on horizontal axis.

subjects had spans falling between 6 and 8 letter-spaces and an average rate of 2.6 words per second, etc. The tables and figures for the elementary subjects show a high positive correlation between rapid reading and a wide eye-voice span.

The comparisons for the high-school pupils are given in Table VIII and Figure 8. Here again a positive correlation is shown between rapid reading and a wide span. The reading rates of the high-school subjects are more nearly uniform than those of the elementary school, all falling within the interval between 2 and 4.9 words per second. The second figure showing the relation between rate and eye-voice span, by using the average span for a base, exhibits a very great variation in the average eye-voice spans. The extremes on both ends of the curve are represented by only a single subject and because of this small number of cases the line for the extremes is dotted instead of solid. The curves are not so steep as those for the elementary school because the increase in rate is less during the high-school years.

Table IX and Figure 9 give the results for the entire group of fifty-four subjects. The evidence here is perfectly clear that a wide eye-voice span is a characteristic of rapid readers for subjects of all grades of advancement from the second grade of the elementary school to the college.

It has been shown in the first part of this chapter that some good readers in the fifth grade have an eye-voice span as wide as many high-school pupils. If it is possible to develop a wide eye-voice span in the first four years of school it would be an aid not only to quality of reading but also to rate. A training experiment, with this aim in view, for pupils in the second, third, and fourth grades, would furnish an interesting problem for further research.

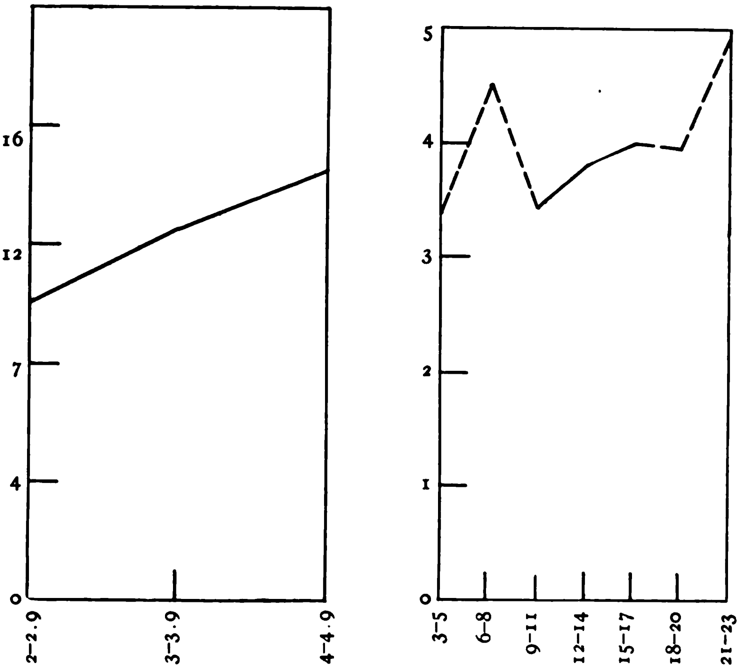
The fact that a wide eye-voice span provides a larger unit of reading material which can be covered by the eye before the voice reaches it makes possible a more rapid oral presentation of the unit without failing to give each word its proper emphasis. The total time for reading such a unit may be reduced by rapid reading, without changing the relative amount of time given to its parts for the sake of proper expression. This cannot be done, however, unless the eye-voice span is wide enough to provide a large unit of meaning. Rapid reading without a correspondingly wide eye-voice span would be a monotonous or "sing-song" pronunciation of words.

Relation of eye-voice span to number of fixations.—An examination of plates giving the records of eye-movement will show that the number

TABLE VIII

RELATION OF EYE-VOICE SPAN TO READING RATE—HIGH-SCHOOL SUBJECTS

NUMBER OF SUBJECTS	RATE IN WORDS PER SECOND	AVERAGE EYE-VOICE SPAN
	By Rate	
1	2–2.9	10.0
16	3–3.9	12.6
7	4–4.9	14.6
	By Eye-Voice Span	
1	3.3	3–5
1	4.5	6–8
4	3.4	9–11
14	3.8	12–14
2	4.0	15–17
1	3.9	18–20
1	4.8	21–23



By rate

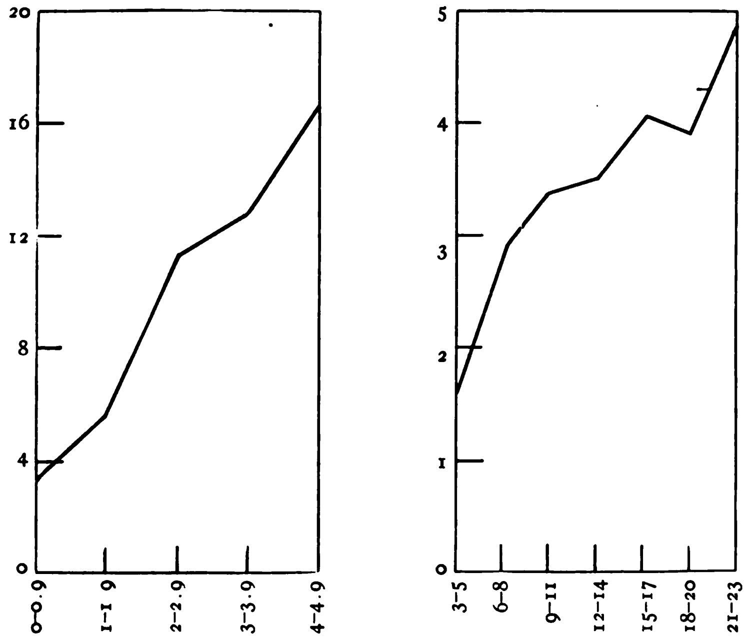
By eye-voice span

FIG. 8.—Relation of eye-voice span to reading rate—high-school subjects. By rate: words per second shown on horizontal axis; average eye-voice span on vertical axis. By eye-voice span: words per second shown on vertical axis; average eye-voice span on horizontal axis.

TABLE IX

Relation of Eye-Voice Span to Reading Rate—All Subjects

Number of Subjects	Rate of Words per Second	Average Eye-Voice Span
	By Rate	
1	0-0.9	3.4
2	1-1.9	5.7
10	2-2.9	11.3
29	3-3.9	12.7
12	4-4.9	16.5
	By Eye-Voice Span	
3	1.6	3-5
7	2.9	6-8
10	3.3	9-11
24	3.5	12-14
4	4.1	15-17
5	3.8	18-20
1	4.8	21-23



By rate By eye-voice span

FIG. 9.—Relation of eye-voice span to reading rate—all subjects. By rate: words per second shown on horizontal axis; average eye-voice span on vertical axis. By eye-voice span: words per second shown on vertical axis; average eye-voice span on horizontal axis.

of fixation pauses per line varies from subject to subject. Table X gives the relation of the width of the eye-voice span to the number of fixations per line, both by eye-voice span and by number of fixations. This table using eye-voice span as a base should be read as follows: Three subjects had an average eye-voice span of from 3 to 5 letter-spaces with an average of 13 fixations per line; seven subjects had an average span of 6 to 8 letter-spaces with an average of 12 fixations per line, etc. The second table is read in the same manner using the average number of fixations per line as a base. Figure 10 gives a graphic representation of the same data. The dotted lines at the right of each curve indicate that a limited number of subjects occurs at the extremes, and that the variation in the general form of the curve is not a characteristic of the subjects as a group. In each case the break in the general form of the curve is caused by a single subject.

TABLE X

Relation of Eye-Voice Span to Average Number of Fixations per Line—All Subjects*

Number of Subjects	Average Eye-Voice Span	Number of Fixations
	By Eye-Voice Span	
3	3–5	13.0
7	6–8	12.0
10	9–11	9.3
24	12–14	9.0
4	15–17	7.9
5	18–20	7.5
1	21–23	9.9
	By Number of Fixations	
13	15.1	6–7
26	12.8	8–9
10	11.5	10–11
2	7.3	12–13
1	12.5	14–15
2	5.7	16–up

* Lines 5 and 6 in high-school selection omitted.

The curves indicate a negative correlation between the width of the eye-voice span and the number of fixations per line. As the size of the span increases the number of fixations decreases. All of the previous studies of eye-movement have shown that a small number of fixations per line is a characteristic of good readers. Consequently it would be expected that the kind of correlation shown by Figure 10 would exist. An experiment attempting to reduce the number of fixations per line by training for a wider eye-voice span might give some interesting results.

Relation of eye-voice span to regressive movements.—One of the characteristic features of both oral and silent reading is that the eye fixations do not progress continuously across a line, but that their progress is interrupted from time to time by backward or regressive movements. The number and length of these regressive movements varies with different subjects, but they are found on the records of all readers. The backward movement of the eye is evidence that the reader has not grasped the entire meaning of the words which the eye has passed over and that a second fixation is needed.

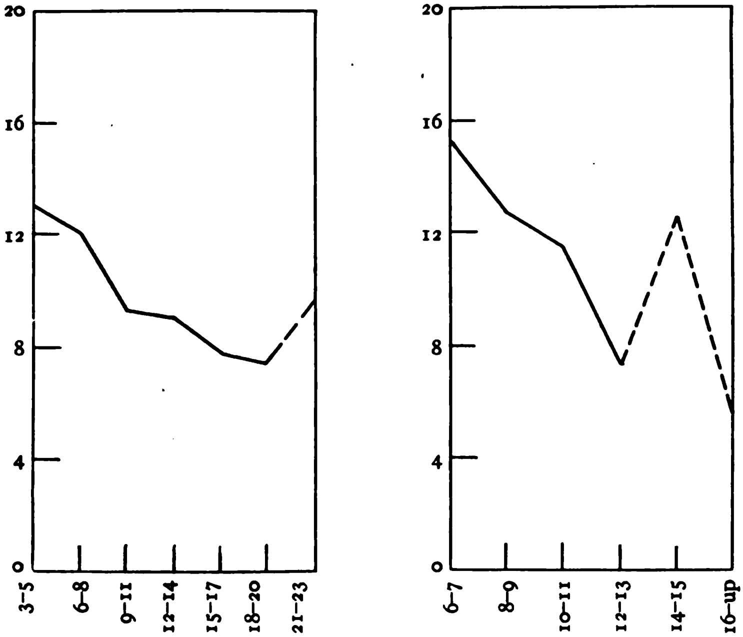


FIG. 10.—Relation of eye-voice span to average number of fixations per line—all subjects. By eye-voice span: average eye-voice span shown on horizontal axis; average number fixations per line on vertical axis. By number of fixations: average number of fixations per line on horizontal axis; average eye-voice span on vertical axis.

It would be expected that subjects having a wide eye-voice span would be able to get the meaning of a sentence with fewer regressive movements than those keeping the eye and voice close together. Accordingly, a study was made of the relation of the eye-voice span to the number of regressive movements per line. The results appear in Table XI. No consistent relationship is shown by this table, except that the subjects having the largest number of regressive movements have a somewhat narrower span.

The fact that no correlation was made apparent by this method of comparison indicates that either none existed or that complicating factors were off-setting each other. If the plates reproduced in the first part of this chapter are studied, it will be seen that there are different kinds of regressive movements.

Plates VI and VII will serve to illustrate these different types of regressive movements. Plate VI shows that this reader makes a great many regressive movements, averaging 5.8 per line. If the serial order of the fixations is followed it will be observed that there is a continual forward and backward movement all along the line. Of the first 10 fixations in the first line 5 are preceded by regressive movements. Eleven fixations with 5 regressive movements are required to recognize the first three words. The cause of such regressive movements is not that the eye passes over words too rapidly and returns to observe some part which has been overlooked, but a general confusion and inability to recognize the words after the eye has seen them. This kind of regressive movement is the mark of very poor reading ability.

TABLE XI

RELATION OF EYE-VOICE SPAN TO NUMBER OF REGRESSIVE MOVEMENTS PER LINE

Number of Subjects	Average Number Regressive Movements per Line	Average Eye-Voice Span
7	0-0.9	12.9
29	1-1.9	12.8
10	2-2.9	13.2
6	3-3.9	10.0
0	4-4.9	....
2	5-5.9	5.7

Plate VII shows the record of a subject who also has a large number of regressive movements, averaging 3.1 per line. It is plainly evident, however, that these backward movements are of an entirely different type from those in Plate VI. In the first line the movement from fixation 5 to fixation 6 is in the backward direction. The reason for this appears to be that the eye has attempted too much in trying to finish the line by one fixation after number 4. It risked a long jump, failed to grasp the entire meaning, and moved back to pick up the part missed. Good reading demands that the jump from fixation to fixation be as long as possible. This reader attempts very long eye-movements all through the selection. Occasionally he fails to grasp as much as the eye covers and the eye must make a regressive movement to recover the words missed. In such a situation, a regressive movement is a characteristic of good rather than of poor reading. It is just the opposite of the practice of the reader shown in Plate VI. For him, the regressive movements were not the result of attempting too long an eye-movement, but were caused by the necessity of seeing every detail of a word before being able to recognize it. The important facts about regressive movements are neither their number nor their length, but are rather concerned with the eye-movements which precede them. A study of regressive movements must, therefore, be based upon the preceding eye-movements. Subject E6, shown in Plate VII, made 16 regressive movements. Of these, nine followed eye-movements of more than ordinary length, being in terms of letter-spaces: 9–9–11–12–13–15–16–16 and 20. Backward eye-movements were necessary for this subject because the eye had attempted to cover too long a distance in the preceding movement. But the effort to cover a long distance is certainly desirable and is characteristic of a mature reader. Compare the record of this reader with that of Subject E3, shown in Plate VI. This subject made 29 regressive movements, and the ten longest eye-movements preceding them are as follows: 8–6–5–5–4–4–4–4–4 and 3. It cannot be said that this subject needed to make backward movements because he attempted too much. His regressive movements were caused by an entirely different reason, and they must be classified as a different type from those of Subject E6.

Such facts as the above make it clear that regressive movements cannot be treated as if they were all of the same nature. They must be analyzed into their various types and each type treated separately. For the purpose of this study, those regressive movements are most important which are caused by the eye attempting to cover too much and failing in the attempt. It would be expected that a reader having a wide eye-voice span would make a larger proportion of this type of regressive movements than of any other. Accordingly a comparison was made to see what relation existed.

The records of each of the subjects were studied and the length of each eye-movement-just-preceding-a-regressive-movement was tabulated. It was found that, for the elementary subjects, the good readers had an average length of this eye-movement of 8.6 letter-spaces as compared with 5.7 spaces for the poor readers. This led to a further analysis of the material. A tabulation of the average length of the eye-movements-just-preceding-regressive-movements for all fifty-four subjects showed that the median length of these movements was 7 letter-spaces and that the upper quartile included all averages greater than 8 letter-spaces. Since this analysis is concerned only with regressive movements which are caused by the eye attempting too great a movement, the eye-movements falling in this upper quartile, those 9 or more letter-spaces in length, were selected for study. Accordingly, a tabulation was made of the percentage of those eye-movements which were 9 or more letter-spaces in length. Since all of these eye-movements were among the upper 25 per cent of the total in length, the regressive movements following them can be attributed to an attempt to make too long a movement of the eye. A comparison can therefore be made showing the relation of eye-voice span to this particular type of regressive movement.

This comparison is shown by Table XII and Figure 11. In this table the first column gives the number of subjects in each division. The second column gives the percentage of eye-movements-just-preceding-regressive-movements 9 or more letter-spaces in length. The third column gives the average eye-voice span for those subjects corresponding to each percentage. The table should be read as follows: There are 16 subjects having from 0 to 9 per cent of their eye-movements-just-preceding-regressive-movements 9 or more letter-spaces in length, and their average eye-voice span is 10.5 letter-spaces; there are 3 subjects having from 10 to 19 per cent of their eye-movements-just-preceding-regressive-movements 9 or more letter-spaces in length, and their average eye-voice span is 7.9 letter-spaces. Figure 11 shows the data graphically. The dotted part at the upper end of the curve signifies that only a limited number of subjects, one for each position, is represented. The dotted line at the beginning of the curve signifies that the first figure is a complex and needs further analysis. Some of the subjects having from 0 to 9 per cent of their eye-movements-just-preceding-regressive-movements 9 or more letter-spaces in length should not properly be used. There are five good readers having 0 per cent of these long eye-movements because they have only a few regressive movements of any kind. These five subjects have an average of less than one regressive movement per line. With this allowance for the first number, the curve is a true representation of the relation of the eye-voice span to the regressive movements caused by too long an eye-movement-just-preceding-a-regressive-movement.

TABLE XII

RELATION OF EYE-VOICE SPAN TO EYE-MOVEMENTS-JUST-PRECEDING-REGRESSIVE-MOVEMENTS—ALL SUBJECTS

Number of Subjects	Percentage of Regressive Movements Preceded by Very Long Eye-Movements	Average Eye-Voice Span
16	0-9	10.5
3	10-19	7.9
9	20-29	10.7
5	30-39	11.5
8	40-49	14.9
6	50-59	16.6
5	60-69	16.0
1	70-79	13.7
1	80-89	13.9

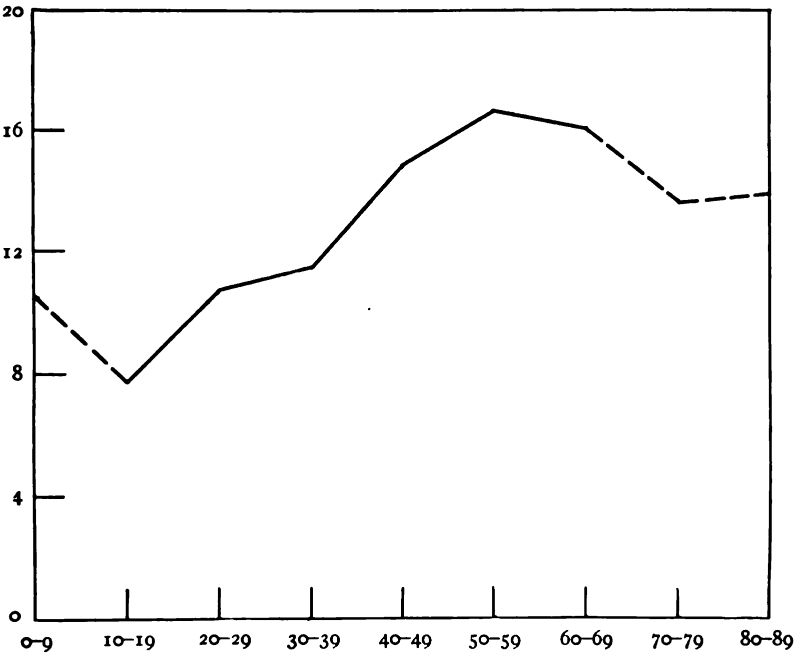


FIG. 11.—Relation of eye-voice span to eye-movements-just-preceding-regressive-movements—all subjects. Average eye-voice span on vertical axis. Percentage of very long eye-movements-just-preceding-regressive-movements on horizontal axis.

This correlation makes it clear that this type of regressive movement is an indication of mature reading habits, and that it is a characteristic of good readers to risk a long eye-movement. It also makes it clear that the regressive movements of subjects having a wide eye-voice span are caused in a greater percentage of cases by attempting a long eye-movement, while those regressive movements of subjects having a narrow eye-voice span are caused more often by confusion in reading and other unanalyzed difficulties. In the first case the regressive movements are sacrifices made in an effort to use a longer eye-movement; in the second case they are in most instances merely attempts to correct difficulties which should never exist and which are not common among mature readers.

SUMMARY OF ANALYSIS OF EYE-VOICE SPAN

The relations of the eye-voice span to other factors of reading as described in this chapter may be summarized as follows:

1. There is a positive correlation between a wide eye-voice span and mature reading. The average span for good readers is greater than that of poor readers in every school grade.

2. The development of the eye-voice span through the school period does not show a consistent increase from grade to grade, but is very irregular. The average span for the high school is greater than that of the elementary school. The average span of the adult subjects is greater than that of those from the high school. But some good readers from the elementary school have a span greater than most of the high-school subjects.

3. The width of the eye-voice span shows little correlation with position in the line, except that the span at the end of a line is slightly narrower. A high correlation is shown between eye-voice span and position in the sentence. The average width of the span at the beginning of a sentence is greater than at the end of the sentence by 46 per cent, while the average within the sentence is greater than that at the end by 23 per cent. These percentages are for all fifty-four subjects including both good and poor readers.

4. A comparison of reading rate with eye-voice span shows that rate of reading and width of eye-voice span increase together. There is a high positive correlation between these two factors of reading.

5. A negative correlation exists between the eye-voice span and the number of fixations per line. As the span increases in width the number of fixations per line decreases.

6. Little correlation is evident between eye-voice span and the number of regressive movements per line. However if the regressive movements are analyzed into their various types, a positive correlation is shown between eye-voice span and that type of regressive movements caused by too long a forward sweep of the eye. As the width of the eye-voice span increases, the percentage of regressive movements caused by this habit of attempting a long forward movement increases. This type of regressive movements must be considered as a characteristic of mature reading.

This study shows that a wide eye-voice span occurs in common with good quality of reading, rapid rate of reading, a small number of fixations per line, and a certain type of regressive movements. All of these qualities may be described as characteristic of a mature reader. It is also evident from the data shown that a narrow eye-voice span occurs with a poor quality of reading, a slow rate, a large number of fixations per line, and a larger percentage of a type of regressive movements which are not characteristic of good reading. These qualities may be considered as characteristic of persons whose reading habits are immature.

The results of the preceding analysis make it very clear that the development of a wide eye-voice span is a significant element in oral reading. As will be shown later, in silent reading a similar meaning-recognition span exists which appears to be closely related, in its development, to the eye-voice span. Since the width of eye-voice span is a factor of mature reading it should receive very definite attention in methods of teaching reading. However, it is difficult to find any allusion to the subject in any of the method texts or manuals. No evidence can be found that elementary teachers in the public schools give any attention to the problem in their teaching, probably because no specific methods are available for dealing with it. Expert teachers of primary reading have worked out a few devices, based upon rapid scanning of phrases and the use of familiar material, which they use in their own classes, but they say that there is nothing available in the literature of reading methods which deals specifically with training for a wider eye-voice span. It is not the function of this investigation to devise methods of teaching, but it is in place to state that here is a significant factor of reading which is in need of specific training methods. The problem is to devise methods which will develop a habit of pushing the eye farther ahead of the voice in order that there may be an interpretation of meaning in larger units.

CHAPTER III

CONTINUOUS RELATIONSHIP OF EYE AND VOICE

In the preceding chapter an analysis was made of the characteristics of the eye-voice span at certain positions in the selections used. It is desirable to know the characteristics of the span at every word and every fixation rather than simply at intervals through a paragraph. Such an analysis is of interest for two reasons: first, it shows the continuous relationship of the eye and voice and the manner in which the variations in the width of the span take place, and secondly, it explains in a measure, the behavior of the eye during the very long fixation pauses which occasionally occur. Such an analysis as just described will be presented in this chapter.

METHOD

It has been explained that a dictaphone record was taken of the oral reading of each subject at the time the eye-movements were photographed. By means of the electric bell and reversed camera shutter, described in the introduction, it was possible to synchronize the voice with the eye-movement record on the film. By this means the position of the eye and voice at the same instant could be determined at intervals through the reading. These locations were shown in the plates in the preceding chapter. By using these locations as basic points, the relation of the eye and voice at any succeeding point could be determined by measuring equal units of time from these bases. The installation of a special spring motor in the dictaphone, which runs with uniform speed from revolution to revolution, insures accuracy for the voice measurement. The measurement of time for the eye is accomplished by adding together the duration of the fixations, while for the voice it is measured by taking the time with a stop-watch from the basic points to each of the following words as they are pronounced on the dictaphone record. This method will be made clear in the next paragraph by reference to a diagram in one of the plates.

Plate XXI shows the record of Subject H1, a good reader from the freshman class. The selection has been duplicated in parallel lines in order to show the eye-voice relationship more clearly. The upper line of the pairs may be called the eye-line, and shows the position and duration of eye-fixations in the same manner as in all of the preceding plates. The lower line of the pairs may be called the voice-line. The diagonal lines connect the positions of the eye and voice for every fixation.

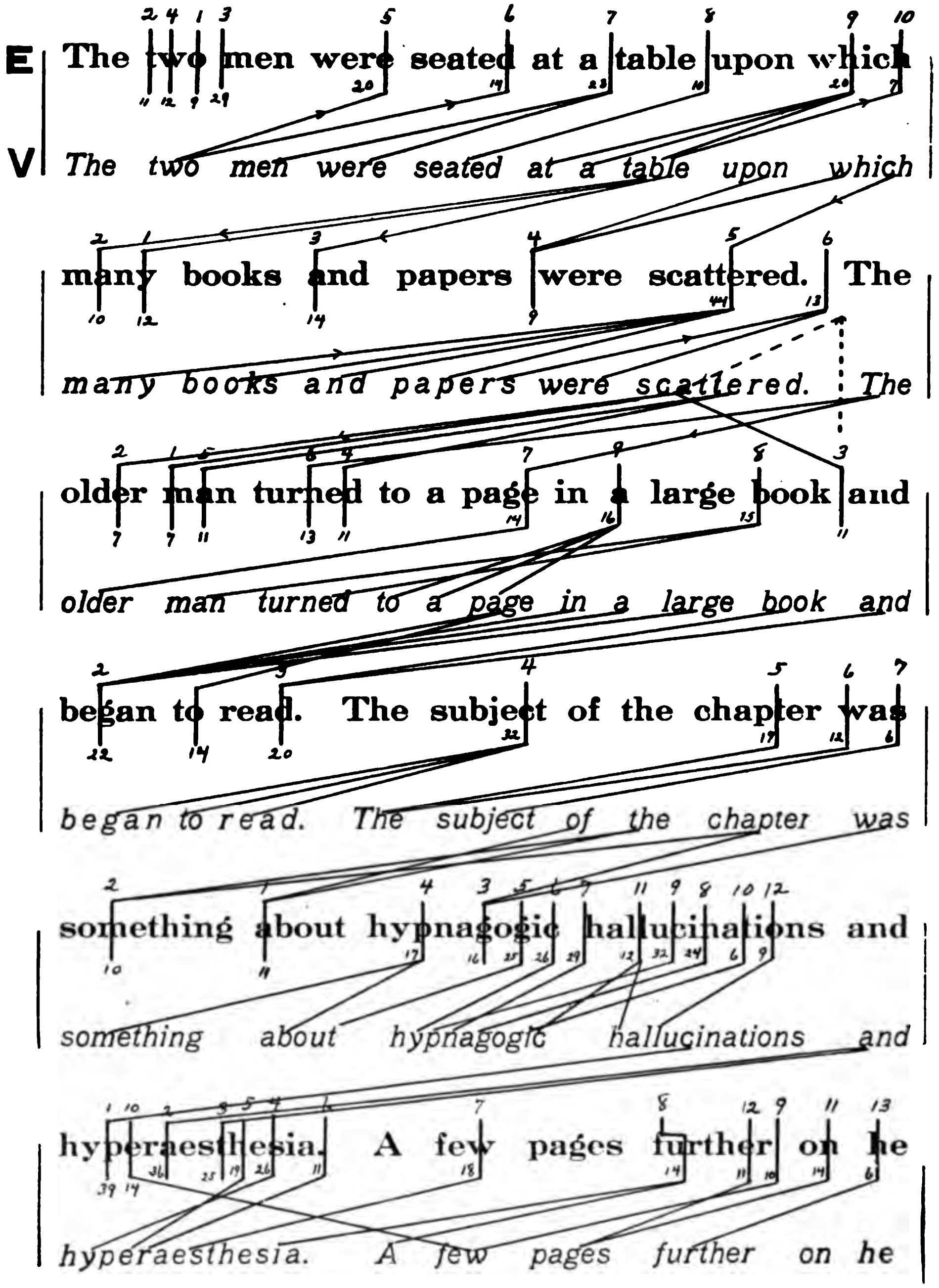
In the record shown in Plate XXI, the positions of the eye and voice were synchronized first as the voice was pronouncing the word "two" in line 1. As the voice began to pronounce "two" the eye was fixated on the last letter of the word "were," which is the fifth fixation in the line. These two points may therefore be taken as a base of measurement for the determination of the relative positions of the eye and voice at the succeeding words and fixations. It will be observed by reference to the plate, that 34 (20+14) fiftieths of a second elapsed during fixations 5 and 6. The time on the stop-watch showed that at a point 34 fiftieths of a second after beginning to pronounce "two," the voice had not begun to pronounce the next word, indicating that fixations 5 and 6 were both made during the time used by the voice in reading the word "two." From fixation 5 to the end of fixation 7 a time of 57 (20+14+23) fiftieths of a second elapsed. The record from the stop-watch and the dictaphone showed that during the interval from 34 fiftieths of a second to 57 fiftieths, the voice had pronounced the words "men" and "were." By a continuation of this form of analysis, the relative positions of the eye and voice were located for every word and every fixation.

The accuracy of the dictaphone time record was made possible by the installation of a special motor which runs with constant speed from revolution to revolution. Only a limited number of subjects were given this form of analysis because of the fact that the method is exceedingly tedious and time-consuming, and also because such a form of analysis can only be applied to film and dictaphone records which are perfect in every detail. The records of nine subjects are shown in Plates XXI–XXIX.

EXPLANATION OF TYPICAL PLATES

The plates may be interpreted either with reference to the eye-line or the voice-line. Arrow heads are inserted for the first few lines of Plate XXI indicating the direction of the eye fixations from the location of the voice. This plate should be read by following the voice-line. While the voice was pronouncing the word "two" the eye was covering fixations 5 and 6, as shown by following the diagonal lines leading from "two." While the voice was pronouncing "men" the eye was located

PLATE XXI


E
V
The two men were seated at a table upon which
The two men were seated at a table upon which
many books and papers were scattered. The
many books and papers were scattered. The
older man turned to a page in a large book and
older man turned to a page in a large book and
began to read. The subject of the chapter was
began to read. The subject of the chapter was
something about hypnagogic hallucinations and
something about hypnagogic hallucinations and
hyperaesthesia. A few pages further on he
hyperaesthesia. A few pages further on he

Continuous eye-voice relationship, Subject H1

PLATE XXIa

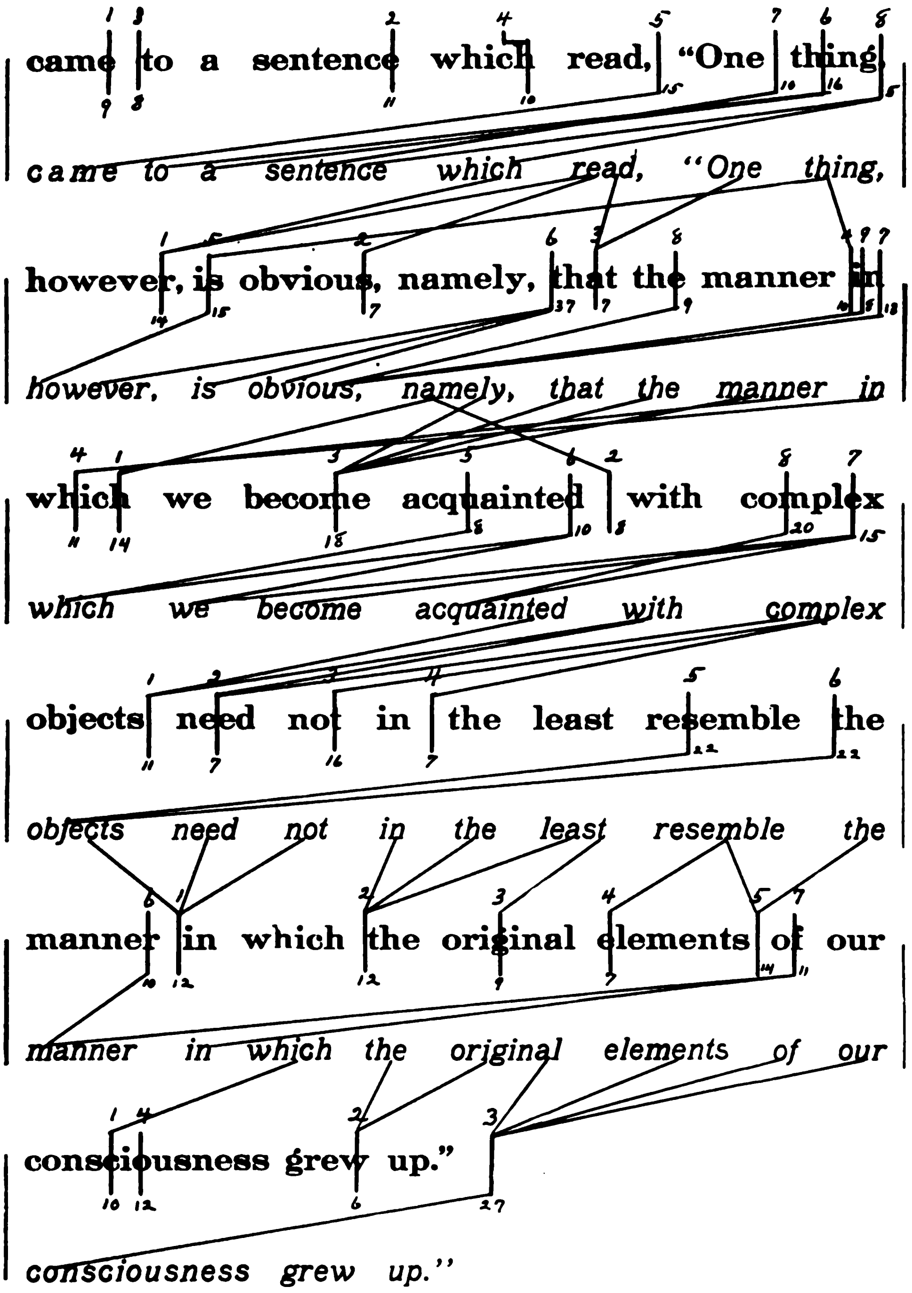

came to a sentence which read, "One thing,
came to a sentence which read, "One thing,
however, is obvious, namely, that the manner in
however, is obvious, namely, that the manner in
which we become acquainted with complex
which we become acquainted with complex
objects need not in the least resemble the
objects need not in the least resemble the
manner in which the original elements of our
manner in which the original elements of our
consciousness grew up."
consciousness grew up."

PLATE XXI—*Continued*

at fixation 7. As the voice was saying "were" the eye was still located at fixation 7. While the voice was pronouncing the word "seated" the eye was fixated at 8. While the voice was saying "at," "a," and the first part of "table," the eye was located at the ninth fixation, but before the voice finished "table" and started on the next word the eye had moved on to fixation 10 in the first line and then to fixations 1, 2, and 3 in the second line. The voice was evidently lagging at this point. As the voice was pronouncing "upon" and the first part of "which," the eye was at the fourth fixation of the second line. While the voice was finishing the word "which" and saying "many books and papers," the eye was held steadily at the fifth fixation in the second line. This fixation was much longer than the average, lasting for 44 fiftieths of a second. The voice moved over all or part of five words during this fixation, making the eye-voice span at the end of the fixation 22 letter-spaces narrower than it was at the beginning.

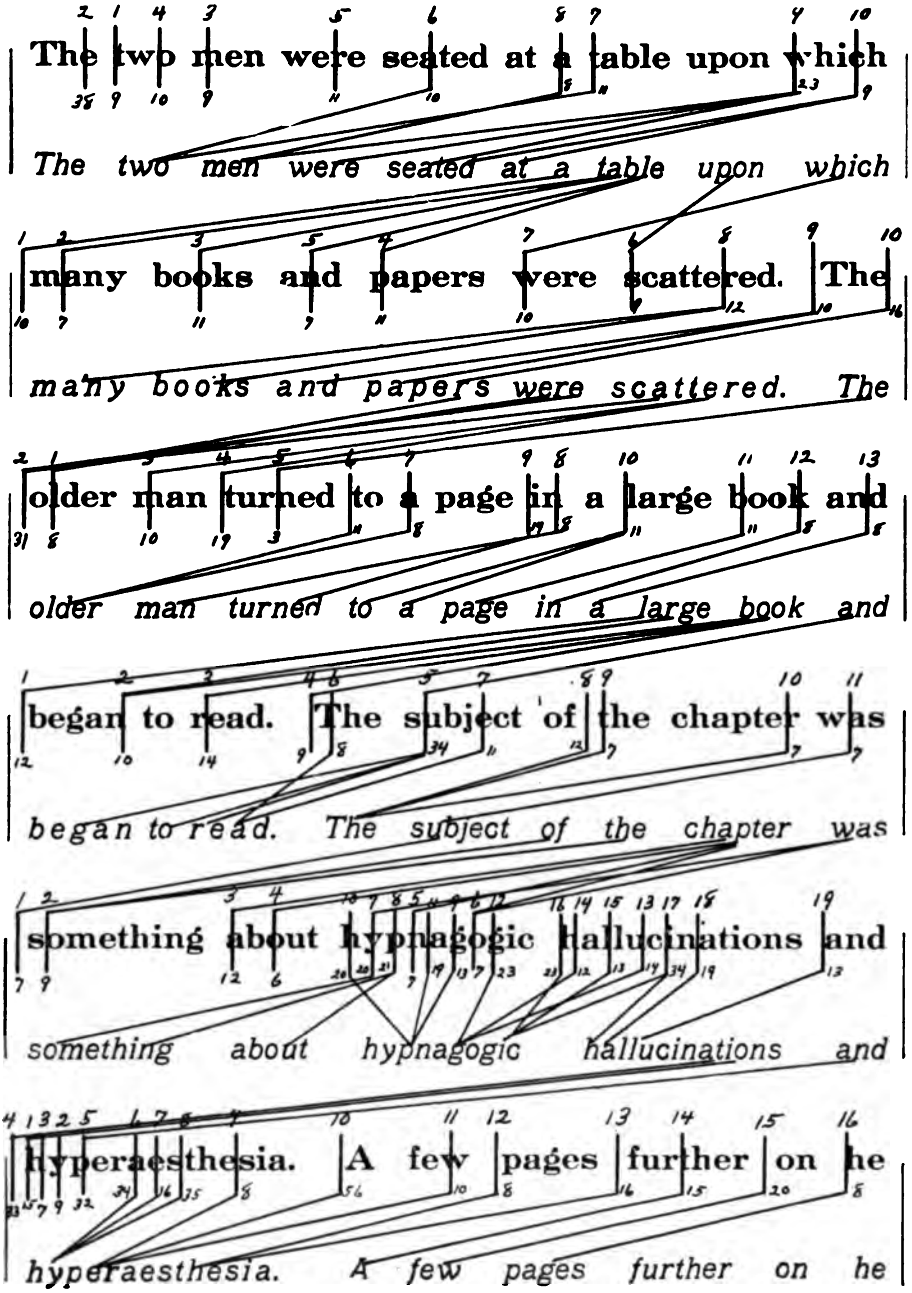
All of the plates are to be read in the same manner. The positions of the eye, while the voice is pronouncing any word, may be found by following the diagonal lines leading from that particular word to the eye-fixations. The position of the voice, while the eye is at any fixation, may be likewise determined by following the diagonal lines leading from that particular fixation to the words in the voice-line. The length of the eye-voice span may be found by counting the number of letter-spaces in the interval between the position of the voice and the eye. If the voice moves over more than one word during a single fixation there will be a maximum and a minimum span, with a range between the spans equal to the distance covered by the voice while the eye is stationary. This maximum and minimum span is well illustrated in the second line of Plate XXI. At fixation 5 in this line the eye remained fixated while the voice covered several words. From the position of the voice to that of the eye at the beginning of the fixation there is a span of 36 letter-spaces, while the distance between the voice and the eye at the end of the fixation is only 14 letter-spaces. In this case the maximum span is 36, the minimum span is 14, and the range of the movement of the voice during the fixation is 22 letter-spaces. The average span at this position would be 25 letter-spaces.

In the third line of Plate XXI an infrequent type of eye-movement occurs which will need explanation. Between the second and fourth fixations in this line the eye made a long sweep to the right, placing the third fixation nearly at the end of the line. An examination of the film will show that there was also an upward movement of the eye, which indicates that instead of fixation 3 being a long look ahead, it was really a regressive movement back to the end of the preceding line. This is indicated in the plate by dotted lines, showing that while this fixation occurred during the series for line 3, it was properly a fixation back upon line 2. This type of movement occurred at intervals in the reading of many of the subjects.

A comparison of the records in Plates XXI–XXIX will bring out the many variations in eye-voice relationship, and will also show the points of general similarity. The elastic nature of the eye-voice span is clearly indicated and the effect of position in the sentence and line can be observed in detail. The effect of the three difficult words introduced in lines 5 and 6 is quite marked, causing an immediate break in the habitual eye-voice relation and reducing the span to nearly zero.

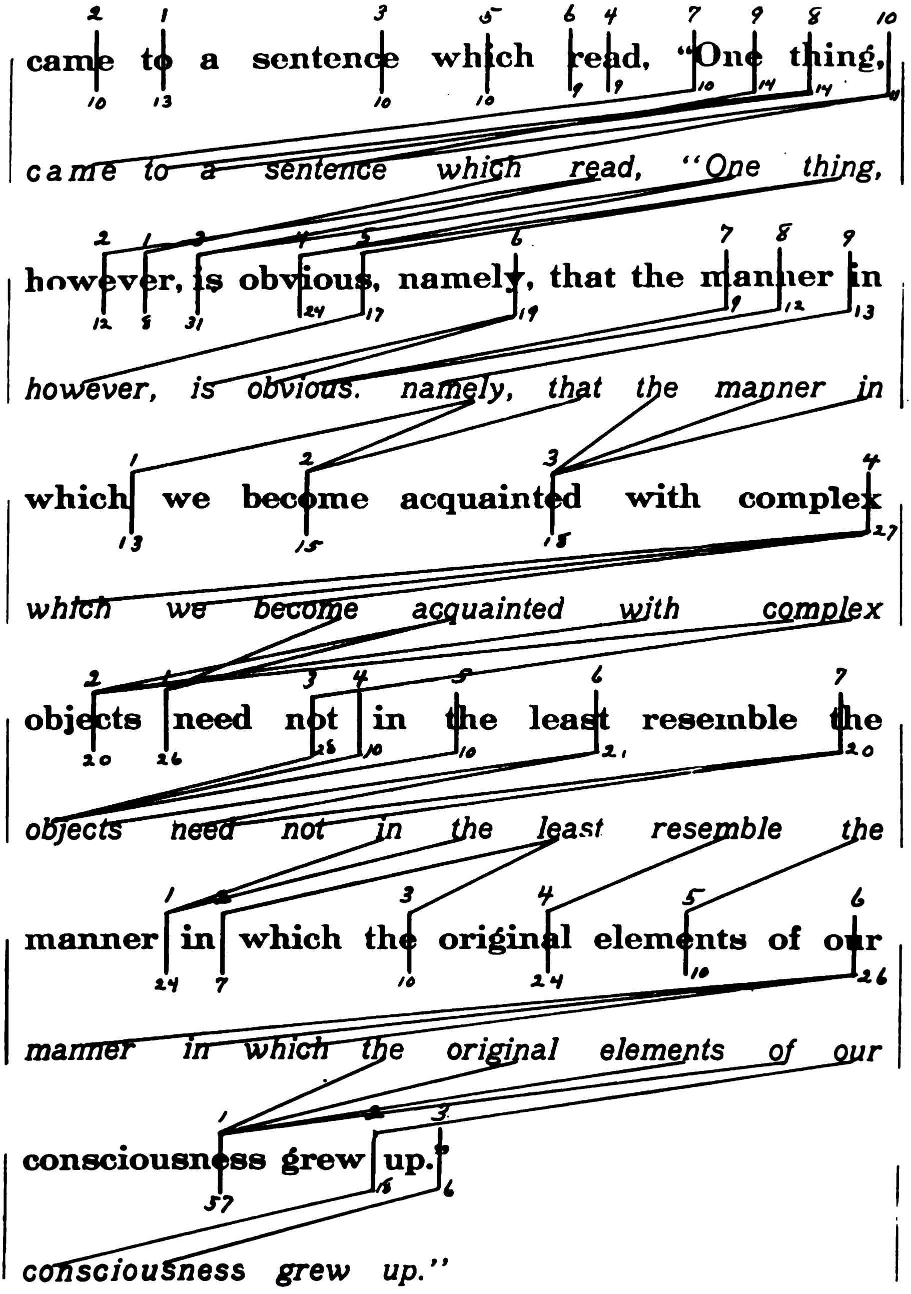
An opportunity is afforded here to check the validity of the method of computing the average span from a few positions in the selection, as was done in the preceding chapter. A comparison shows that when the average span for every fixation is used, the average span for the selection is a little wider than when computed from the eight or nine positions in the paragraph. For Subjects H1 and E1, Plates XXI and XXVIII, the average span obtained by using every fixation was 3.2 letter-spaces longer than when averaged from the nine positions in the paragraph. The reason for this difference is easily explained. The average eye-voice span for the end of a sentence was found to be much narrower than for other points in the selection. For the eight positions used in the elementary-school selection, two were at or near the end of a sentence. The average for the selection, therefore, was influenced by 25 per cent of the samples representing eye-voice spans which varied from the average more than did the other 75 per cent. In the whole elementary selection there were only three sentences and consequently only a few words influenced by being in that position. However, there were forty-three words in the entire selection, which very materially reduced the influence which the narrower span, at the end of sentences, would have on the general average. The same would be true for the high-school selection. Since it has been shown that the relative shortening of the span at the end of a sentence is more evident with good than with poor readers, and since both Subjects H1 and E1 are good readers, the error in the averages for the poor readers would be still less than for these two subjects. Whatever small amount of error does exist for the sampling method, it would affect the results of the preceding chapter in only one respect: it would slightly enlarge the difference in the width

PLATE XXII


The two men were seated at a table upon which
The two men were seated at a table upon which
many books and papers were scattered. The
many books and papers were scattered. The
older man turned to a page in a large book and
older man turned to a page in a large book and
began to read. The subject of the chapter was
began to read. The subject of the chapter was
something about hypnagogic hallucinations and
something about hypnagogic hallucinations and
hyperaesthesia. A few pages further on he
hyperaesthesia. A few pages further on he

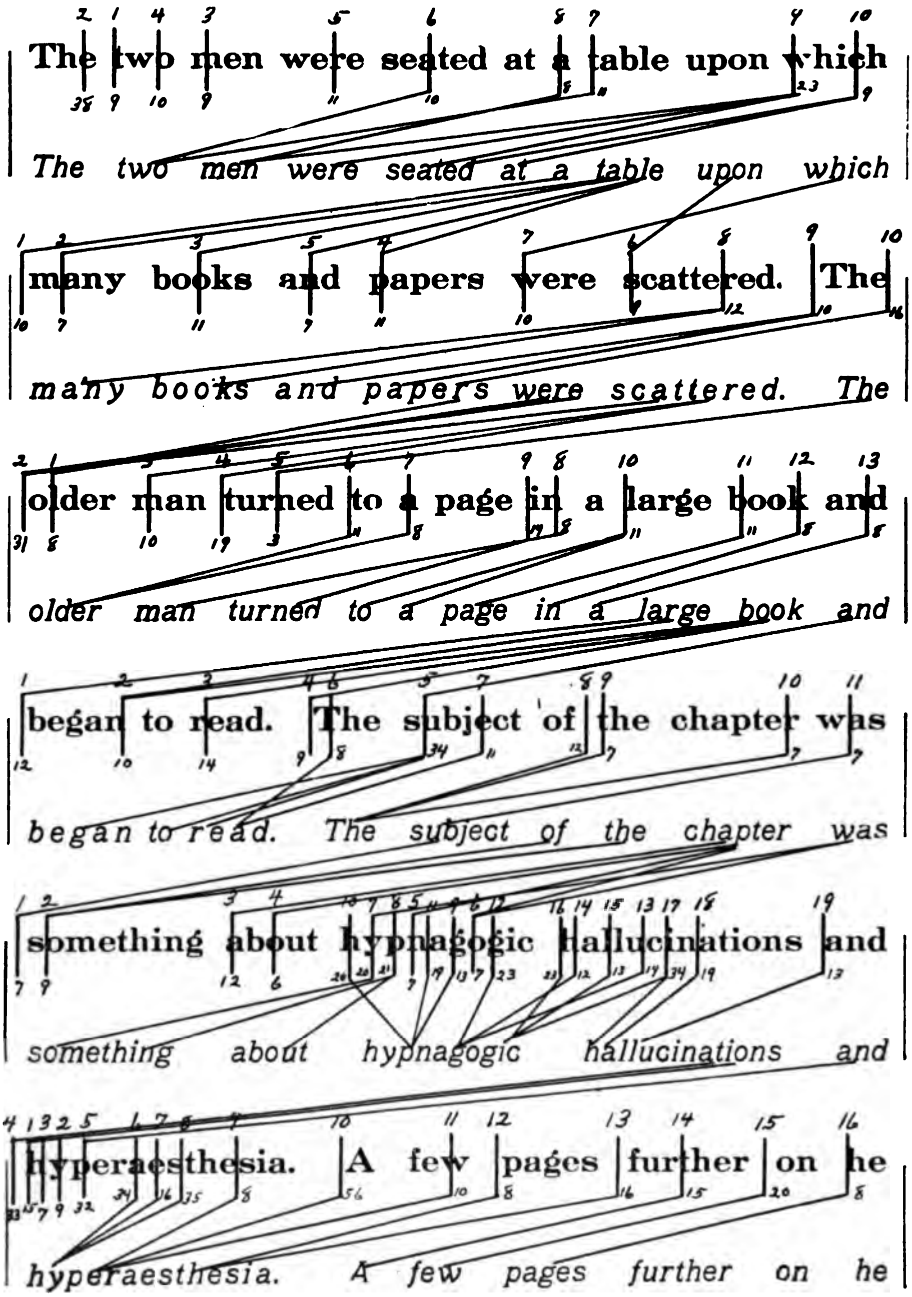
Continuous eye-voice relationship, Subject H5

PLATE XXIII


came to a sentence which read, "One thing,
came to a sentence which read, "One thing,
however, is obvious, namely, that the manner in
however, is obvious, namely, that the manner in
which we become acquainted with complex
which we become acquainted with complex
objects need not in the least resemble the
objects need not in the least resemble the
manner in which the original elements of our
manner in which the original elements of our
consciousness grew up.
consciousness grew up."

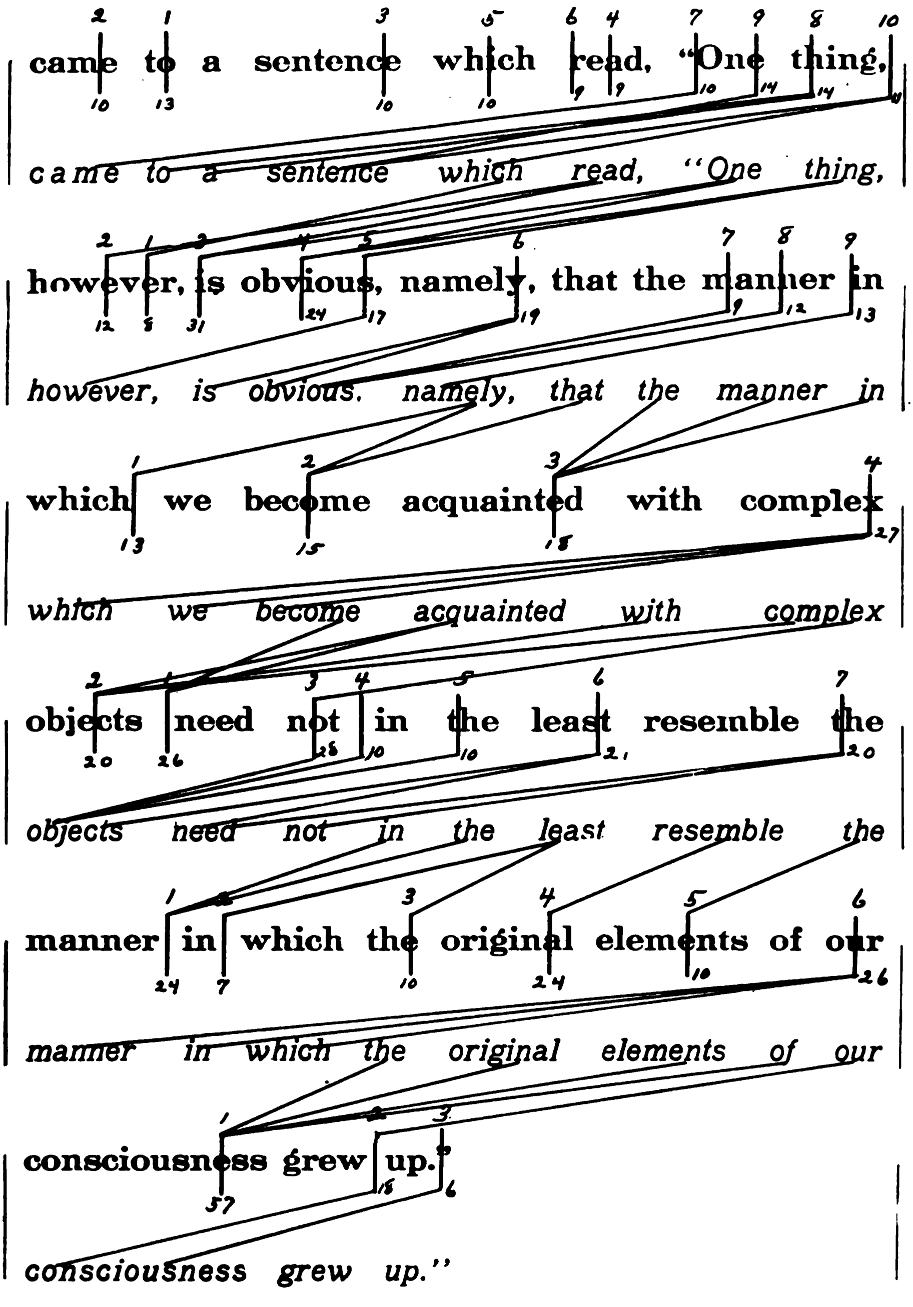
Continuous eye-voice relationship, Subject H8

PLATE XXII


The two men were seated at a table upon which
The two men were seated at a table upon which
many books and papers were scattered. The
many books and papers were scattered. The
older man turned to a page in a large book and
older man turned to a page in a large book and
began to read. The subject of the chapter was
began to read. The subject of the chapter was
something about hypnagogic hallucinations and
something about hypnagogic hallucinations and
hyperaesthesia. A few pages further on he
hyperaesthesia. A few pages further on he

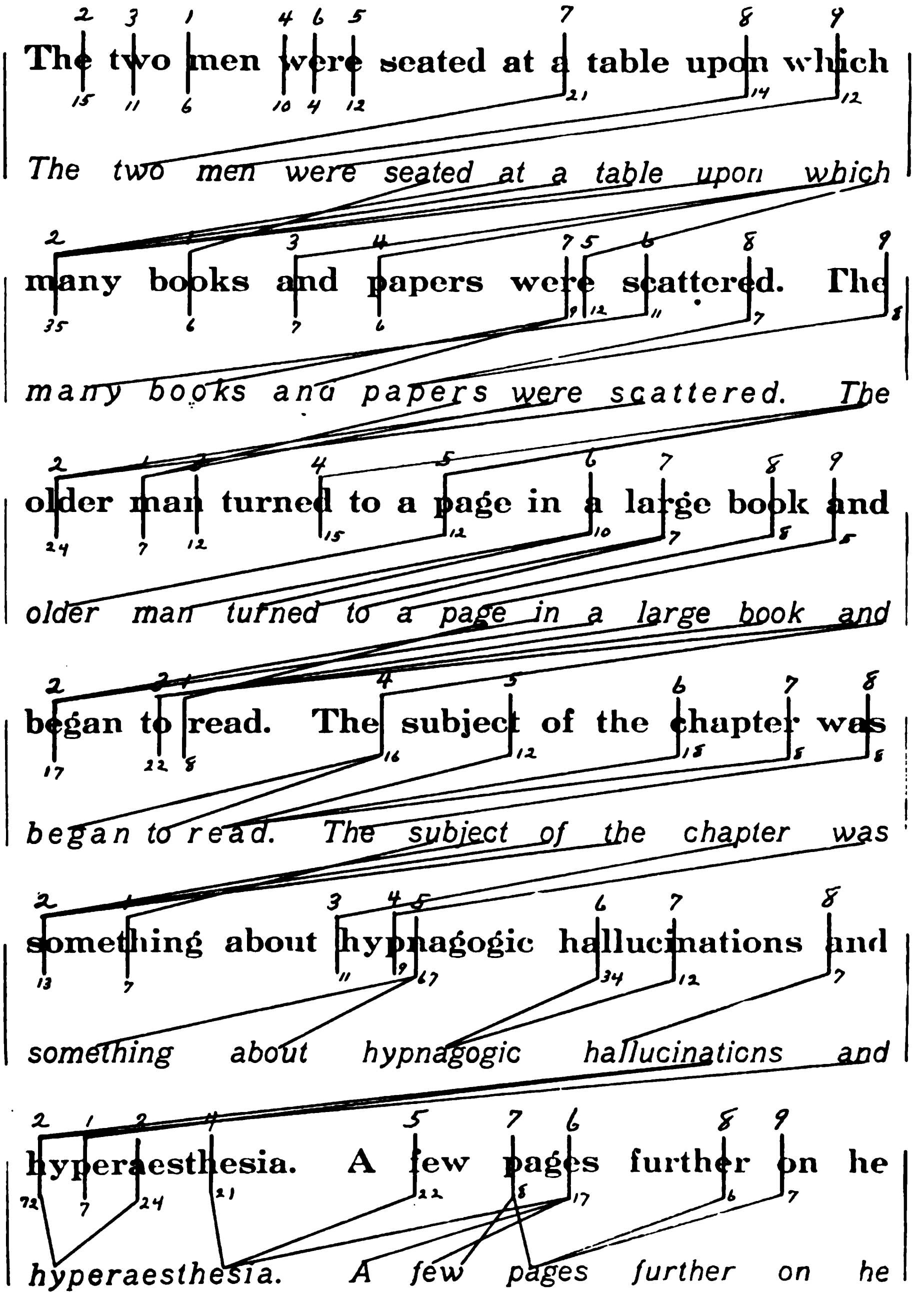
Continuous eye-voice relationship, Subject H5

PLATE XXIII


came to a sentence which read, "One thing,
came to a sentence which read, "One thing,
however, is obvious, namely, that the manner in
however, is obvious, namely, that the manner in
which we become acquainted with complex
which we become acquainted with complex
objects need not in the least resemble the
objects need not in the least resemble the
manner in which the original elements of our
manner in which the original elements of our
consciousness grew up."
consciousness grew up."

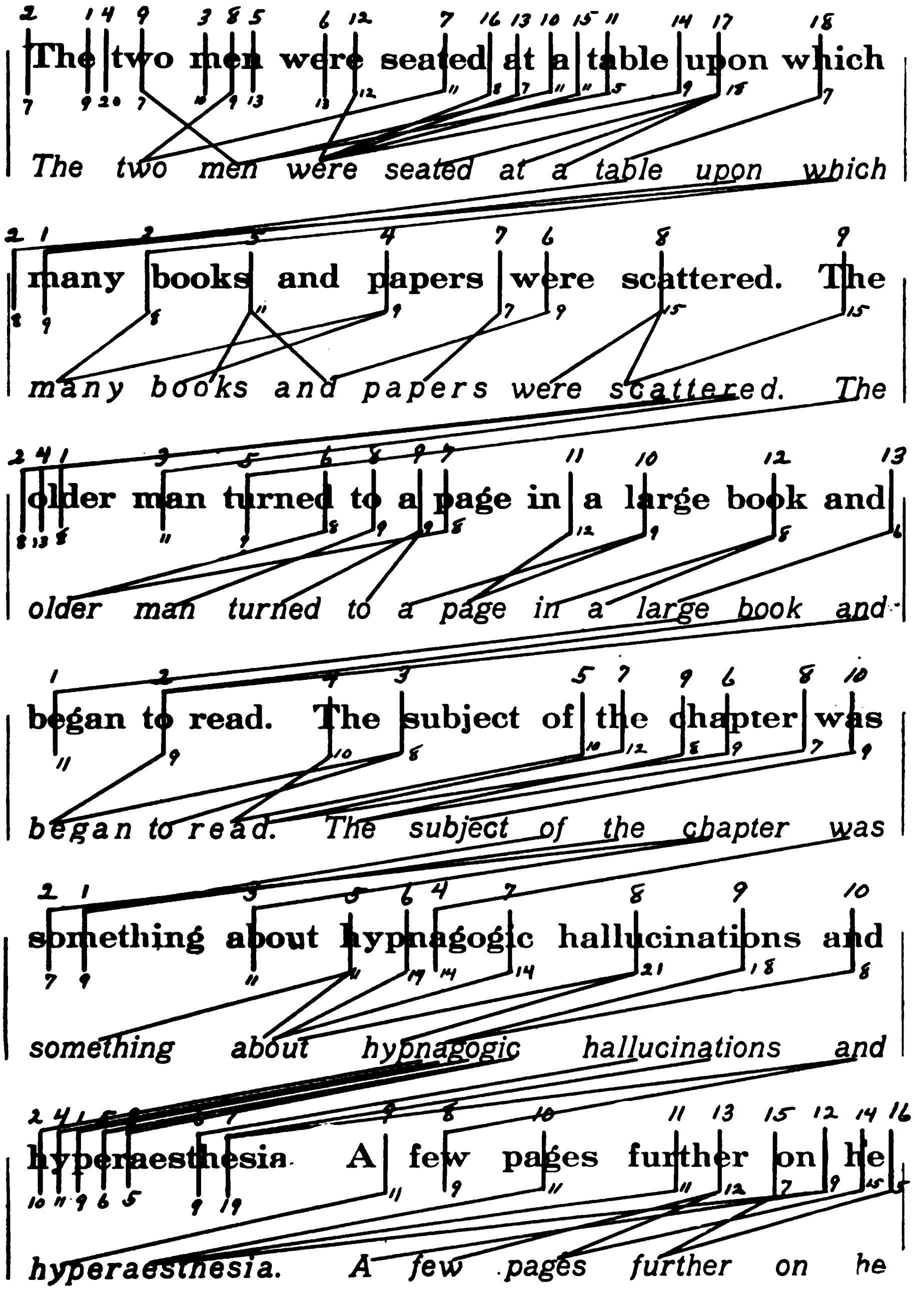
Continuous eye-voice relationship, Subject H8

PLATE XXIV


2 3 1 4 6 5 7 8 9
The two men were seated at a table upon which
15 11 6 10 4 12 21 14 12
The two men were seated at a table upon which
2 1 3 4 7 5 6 8 9
many books and papers were scattered. The
35 6 7 6 9 12 11 7 8
many books and papers were scattered. The
2 1 3 4 5 6 7 8 9
older man turned to a page in a large book and
24 7 12 15 12 10 7 8 5
older man turned to a page in a large book and
2 3 1 4 5 6 7 8
began to read. The subject of the chapter was
17 22 8 16 12 15 5 8
began to read. The subject of the chapter was
2 1 3 4 5 6 7 8
something about hypnagogic hallucinations and
13 7 11 9 17 34 12 7
something about hypnagogic hallucinations and
2 1 3 4 5 7 6 8 9
hyperaesthesia. A few pages further on he
72 7 24 21 22 8 17 6 7
hyperaesthesia. A few pages further on he

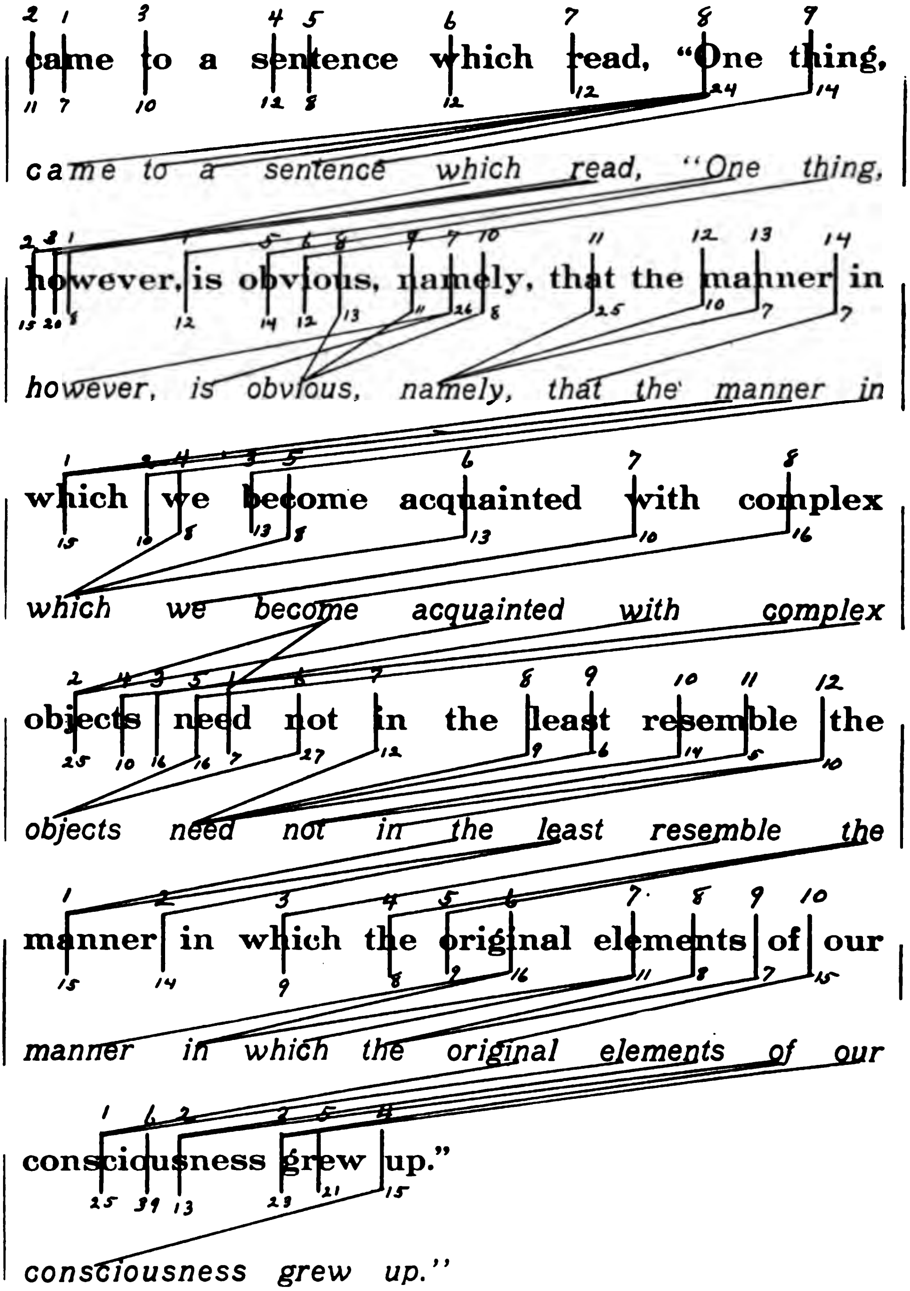
Continuous eye-voice relationship, Subject H10

PLATE XXV


The two men were seated at a table upon which
The two men were seated at a table upon which
many books and papers were scattered. The
many books and papers were scattered. The
older man turned to a page in a large book and
older man turned to a page in a large book and
began to read. The subject of the chapter was
began to read. The subject of the chapter was
something about hypnagogic hallucinations and
something about hypnagogic hallucinations and
hyperaesthesia. A few pages further on he
hyperaesthesia. A few pages further on he

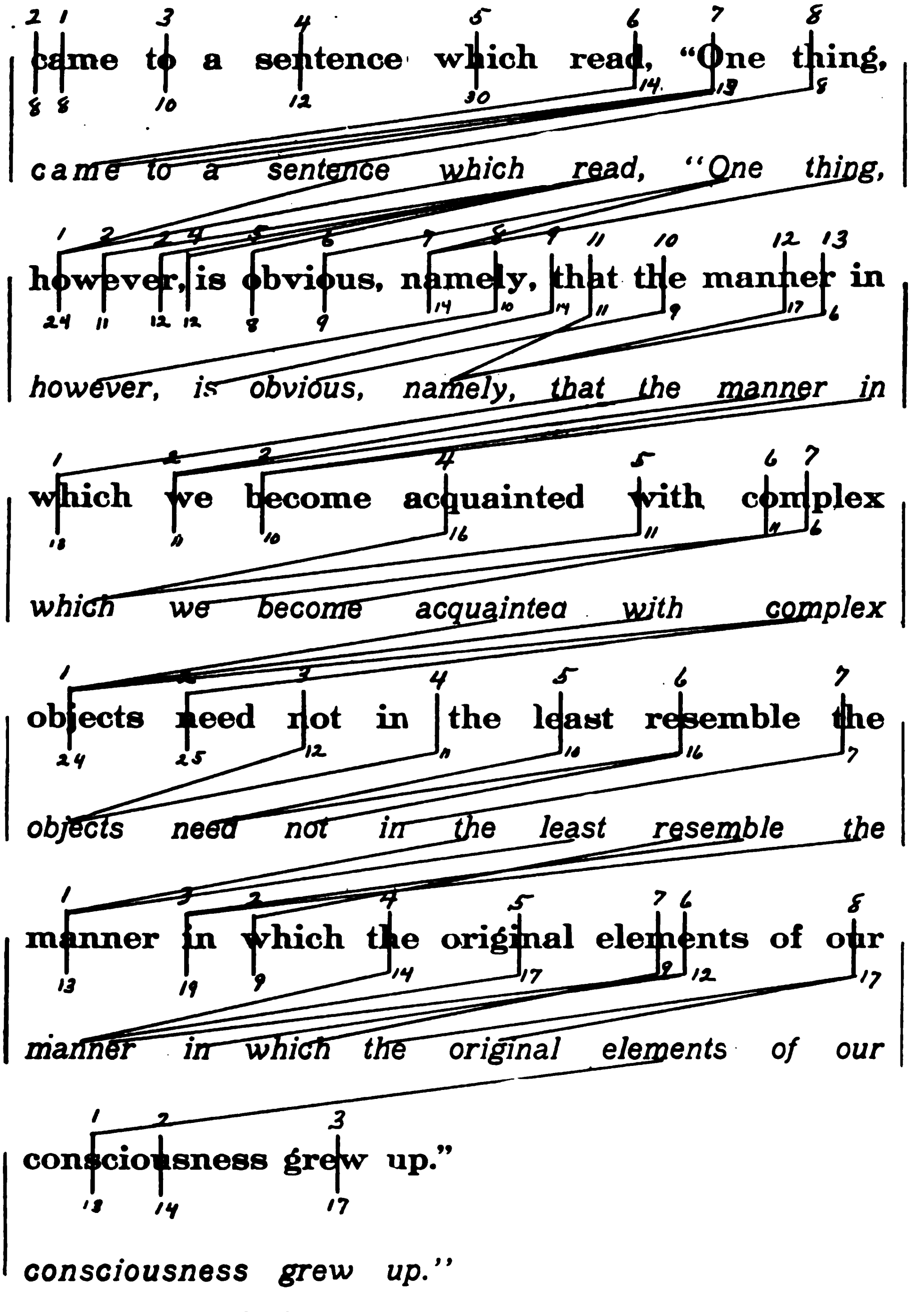
Continuous eye-voice relationship, Subject H22

PLATE XXVI


came to a sentence which read, "One thing,
came to a sentence which read, "One thing,
however, is obvious, namely, that the manner in
however, is obvious, namely, that the manner in
which we become acquainted with complex
which we become acquainted with complex
objects need not in the least resemble the
objects need not in the least resemble the
manner in which the original elements of our
manner in which the original elements of our
consciousness grew up."
consciousness grew up."

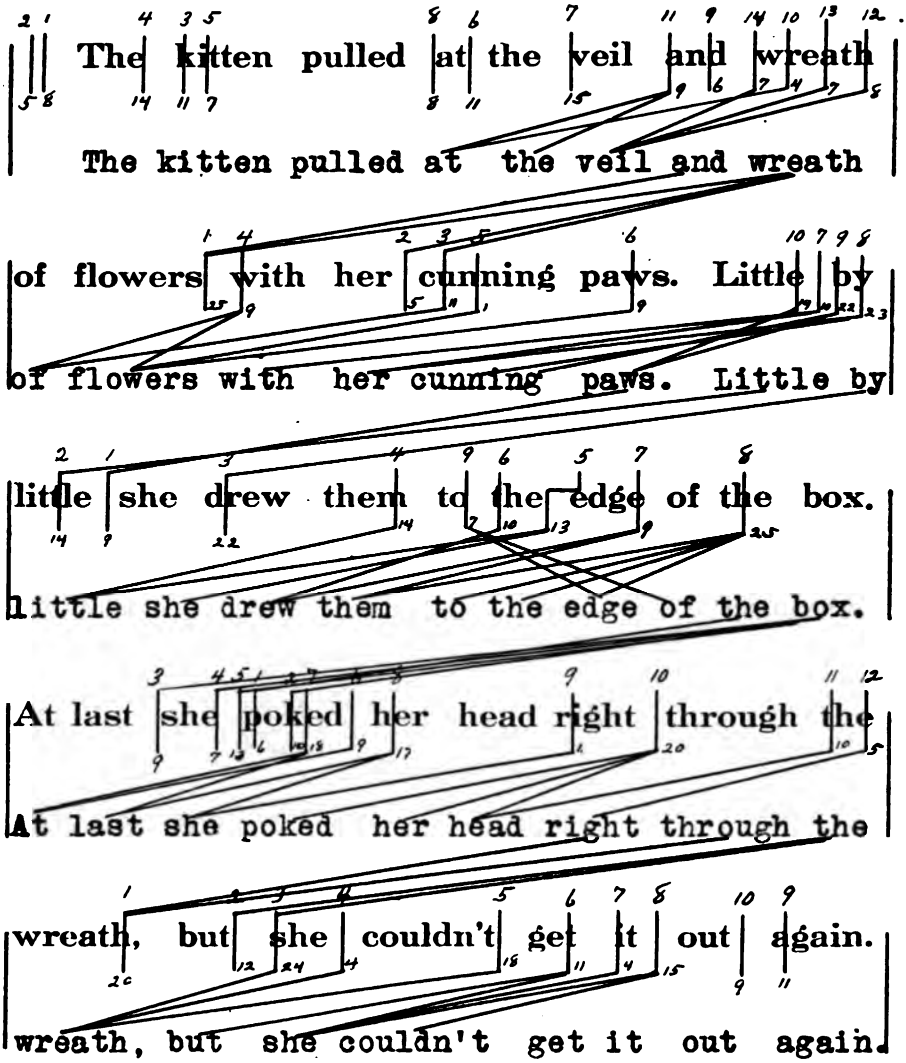
Continuous eye-voice relationship, Subject H23

PLATE XXVII


came to a sentence which read, "One thing,
came to a sentence which read, "One thing,
however, is obvious, namely, that the manner in
however, is obvious, namely, that the manner in
which we become acquainted with complex
which we become acquainted with complex
objects need not in the least resemble the
objects need not in the least resemble the
manner in which the original elements of our
manner in which the original elements of our
consciousness grew up."
consciousness grew up."

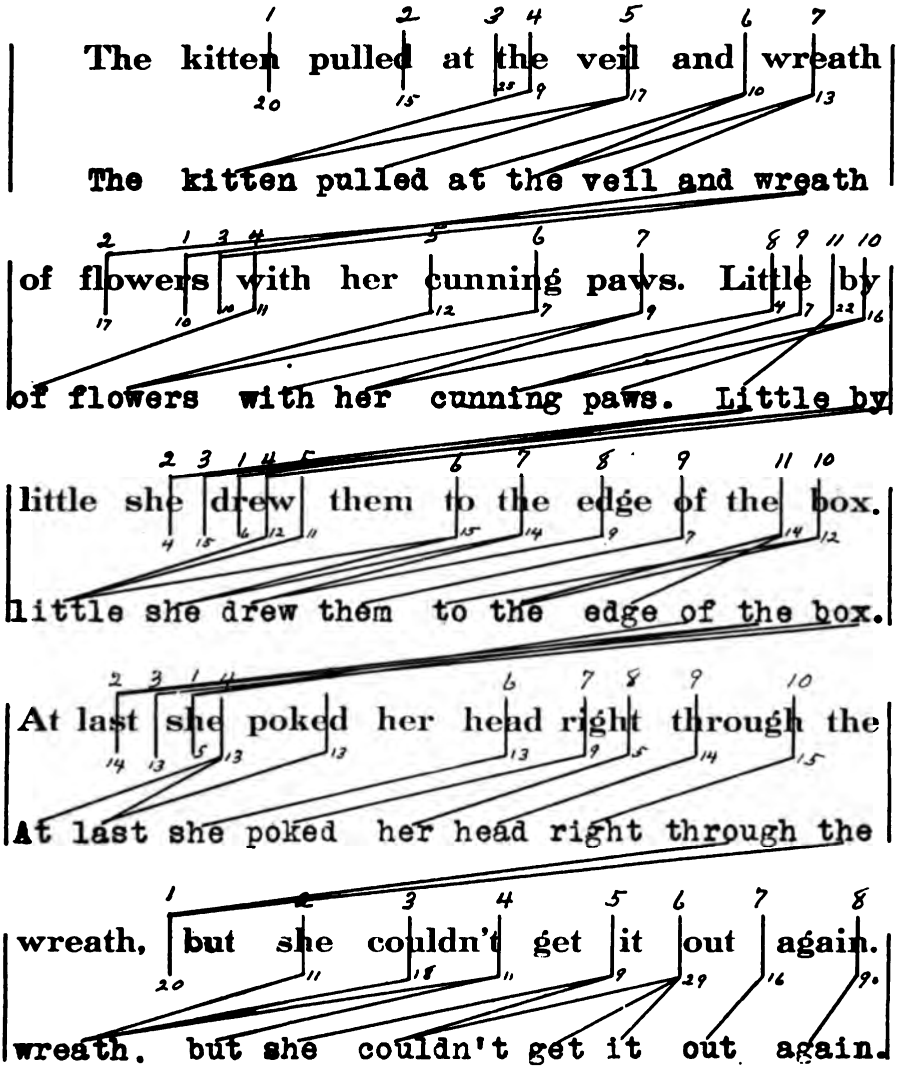
Continuous eye-voice relationship, Subject A3

PLATE XXVIII


The kitten pulled at the veil and wreath
The kitten pulled at the veil and wreath
of flowers with her cunning paws. Little by
of flowers with her cunning paws. Little by
little she drew them to the edge of the box.
little she drew them to the edge of the box.
At last she poked her head right through the
At last she poked her head right through the
wreath, but she couldn't get it out again.
wreath, but she couldn't get it out again.

Continuous eye-voice relationship, Subject E1

PLATE XXIX


The kitten pulled at the veil and wreath
The kitten pulled at the veil and wreath
of flowers with her cunning paws. Little by
of flowers with her cunning paws. Little by
little she drew them to the edge of the box.
little she drew them to the edge of the box.
At last she poked her head right through the
At last she poked her head right through the
wreath, but she couldn't get it out again.
wreath, but she couldn't get it out again.

Continuous eye-voice relationship, Subject E5 of span which was shown to exist between the good and the poor readers. It would have no influence on the other results since they are all in the nature of relative comparisons and whatever difference exists would exist for the whole group.

ELASTIC NATURE OF THE EYE-VOICE SPAN

One of the characteristic features of the eye-voice span is its variation in width from word to word through the selection. The span is sometimes very wide and sometimes narrow, apparently expanding and contracting according to the demands made by the material read. Table XIII shows this elastic nature of the span for four lines of the reading of Subject Hi. This table gives the maximum and the minimum eye-voice span, the range, and the duration of the pause for each

TABLE XIII

ELASTICITY OF EYE-VOICE SPAN—SUBJECT HI

Line and Fixation Number	Maximum Eye-Voice Span	Minimum Eye-Voice Span	Range of Span	Length of Fixation
II-1	18	17	1	12
II-2	15	14	1	10
II-3	24	23	1	14
II-4	32	25	7	9
II-5	36	13	23	44
II-6	18	10	8	13
III-1	21	19	2	7
III-2	16	14	2	7
III-3	7	5	2	11
III-4	24	22	2	11
III-5	14	11	3	11
III-6	17	15	2	13
III-7	27	19	8	14
III-8	32	21	11	15
III-9	13	6	7	16
IV-1	30	29	1	14
IV-2	24	11	13	22
IV-3	21	12	9	20
IV-4	24	10	14	32
IV-5	24	23	1	17
IV-6	26	23	3	12
IV-7	25	17	8	6
XI-1	44	34	10	12
XI-2	41	31	10	12
XI-3	39	37	2	9
XI-4	45	41	4	7
XI-5	46	37	9	14
XI-6	5	2	3	10
XI-7	36	29	7	11

fixation in lines 2, 3, 4, and 11. In the second line the maximum span is comparatively small, then large and finally small again. In the fourth line the maximum span is wide for every fixation but the minimum span shows considerable variation. In line 11 there is an exceptionally wide maximum span for every fixation except the sixth. The reason for this variation is that fixation 6 makes a long regressive movement which cuts the span nearly to zero. The eye-voice span of this subject shows an elasticity both within the line and from line to line. The relation of the eye and voice is apparently adjusted according to the demands made upon the reader by the material. As noted in the preceding chapter, the beginning and end of a sentence demand a different type of eye-voice span. There are without doubt other factors which influence the width of the span, among which difficult words and difficult meaning would have a place. It has already been shown that the eye-voice span of the immature reader is narrow, while pupils with more mature reading habits have a wider span. An examination of Plates XXI, XXII, XXIV, and XXV shows very clearly that when the difficult words in lines 5 and 6 are encountered the subjects who are mature readers return at once to a type of reading which can be described as less advanced and keep their eye and voice very close together. The elastic nature of the eye-voice span is very evident when such difficult words are encountered. A more detailed anaylsis of the reaction to difficult words will be given in the latter part of this chapter.

RELATION OF EYE-VOICE SPAN TO LENGTH OF FIXATIONS

An examination of the records of the subjects used in this investigation will show that while the median duration of a fixation pause varies from 9 to 13 fiftieths of a second, there frequently occur fixations which are very much longer. A tabulation of the fixation pauses of nineteen high-school subjects shows an average for each subject of 14 fixations which are more than 20 fiftieths of a second in length. The length of these long fixations varies from 20 to 93 fiftieths of a second. This unusual behavior on the part of the eye calls for an explanation. It was thought that an analysis of the continuous relationship of the eye and voice might help to explain the long fixations by showing what the voice was doing during those comparatively long intervals. The cause of these long fixations may be due to a number of factors. One possible hypothesis is that a long fixation occurs when the eye reaches too great a distance ahead of the voice, and that the eye remains fixated until the voice catches up to a convenient position, when the eye moves forward again. In terms of this hypothesis a long fixation would mean a period during which the voice was trying to catch up with the eye.

In order to test this hypothesis a study was made of the ten longest and ten shortest fixations for each of ten subjects. The average maximum and minimum spans and the range were tabulated for each subject. If the hypothesis were true, the maximum span and the range should be greater for the long fixations than for the short ones. Such a condition would be evidence that, in case of the long fixations, the eye had been leading by too wide a span and that a long fixation was provided for the voice to catch up. The result of the comparison of the fixations of the ten subjects is given in Table XIV. The table should be read as follows: The record of Subject E1 shows, for the ten longest fixations, an average maximum span of 18.6 letter-spaces an average minimum span of 11.9 letter-spaces, and a range of 6.7 spaces; and for the ten shortest fixations, a maximum span of 15.3 letter-spaces, a minimum span of 13.4 spaces and a range of 1.9 spaces.

TABLE XIV

RELATION OF EYE-VOICE SPAN TO LENGTH OF FIXATIONS

SUBJECT	TEN LONGEST FIXATIONS			TEN SHORTEST FIXATIONS		
	Maximum Span	Minimum Span	Range	Maximum Span	Minimum Span	Range
E1	18.6	11.9	6.7	15.3	13.4	1.9
E5	14.9	8.1	6.8	16.7	13.5	3.2
E8	14.1	9.3	4.8	13.8	11.6	2.2
H1	27.7	16.0	11.7	29.6	24.3	5.3
H5	18.9	10.7	8.2	17.6	15.0	2.6
H8	31.4	21.6	9.8	25.9	22.0	3.9
H10	22.8	11.8	11.0	23.0	19.6	3.4
H22	22.5	13.9	8.6	15.0	12.2	2.8
H23	20.8	11.3	9.5	18.6	15.2	3.4
A3	20.4	11.5	8.9	20.0	17.0	3.0
Average	21.2	12.6	8.6	19.6	16.4	3.2

The averages for all of the ten subjects do not fully justify the hypothesis. The maximum span for the long fixations is greater than that for the short fixations, but only by a small amount. It is not a satisfactory explanation to say that an average span of 21.2 letter-spaces was so great as to cause a very long fixation, while a span of 19.6

letter-spaces was not found inconvenient and was accompanied by the shortest fixations. The difference is not great enough to justify the hypothesis, and the conclusion must be drawn that width of eye-voice span is at least not a large factor in the cause of long fixations.

The average range, for all subjects, for the long fixations is 8.6 letter-spaces, while for the short fixations it is only 3.2 letter-spaces. This cannot be regarded as an explanation of the cause of the long fixations, but it merely shows that the voice is moving over a greater range during the long pauses.

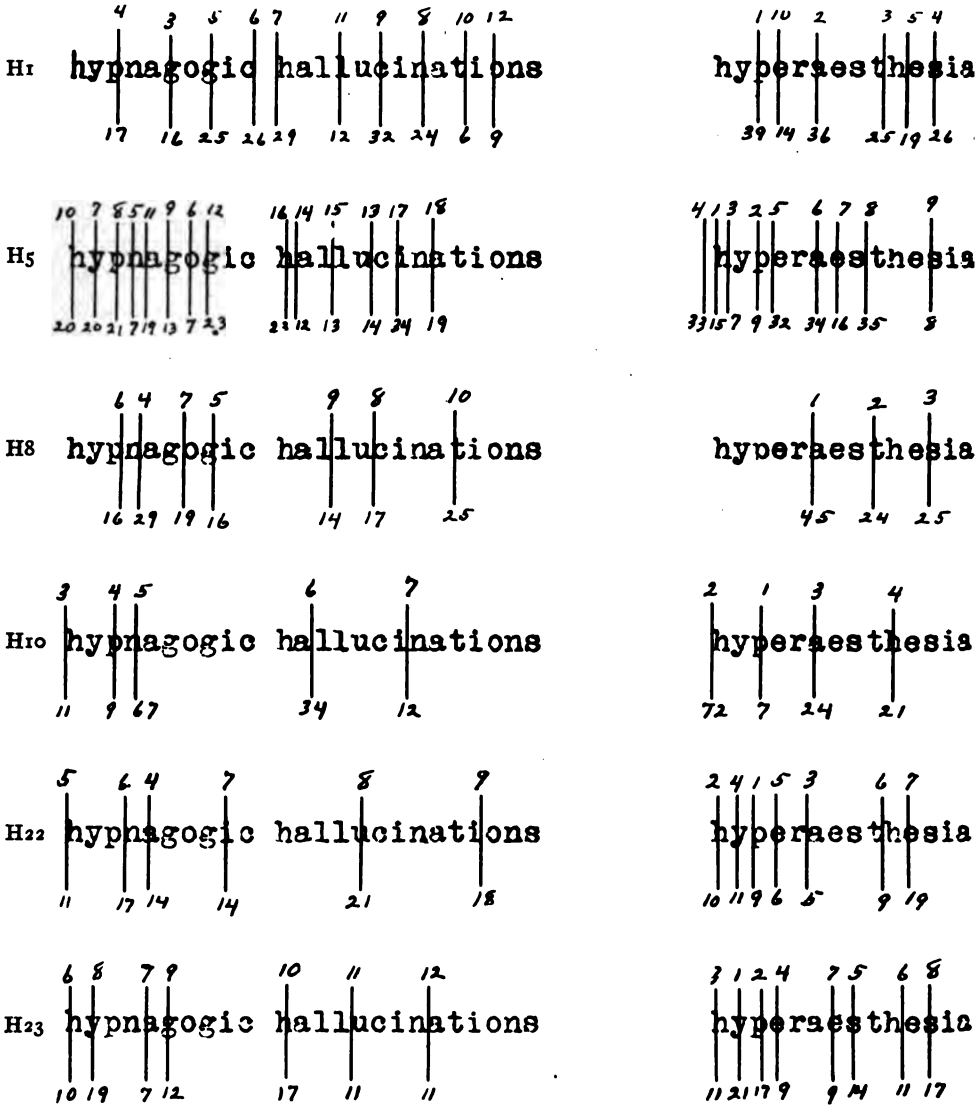
The data presented in Table XIV cannot be regarded as sufficient evidence to establish a causal relationship between a long eye-voice span and a long fixation pause. When the span becomes too long for convenience the eye seems to react by a series of short fixations covering small intervals as often as by a single long fixation. The eye is the controlling factor rather than the voice, and other factors of perception must operate to lengthen the eye pauses.

A cue to a possible cause of the long fixations may be found from another source than the eye-voice span. The eye-movements of all high-school subjects were radically modified when the three difficult words in lines 5 and 6 were reached. These words were new to all of the high-school subjects. Two characteristic differences are evident in the behavior of the eye toward these words. The number of fixations is greater and the percentage of long fixations is larger when the difficult words are encountered.

Plate XXX shows a comparison of the eye-movements of six high-school subjects in reading these three words. The column of numbers at the right of the plate gives the median length of all fixations. The first line of the plate gives the record of Subject H1. The median length of the fixations of this subject for the whole selection was 12 fiftieths of a second. In reading these words 13 of the 17 fixations are longer than the median. Of these 13 fixations, 9 are more than twice as long as the median for the selection. Subject H5, in the next line, makes 23 fixations on the three words, 18 of which are longer than the median. Subject H10, in the fourth line, makes only 9 fixations of which 6 are greater than the median. Two of these 6 are very long, however, being 67 and 72 fiftieths of a second.

The results shown by Plate XXX make it clear that difficult words are one cause of long fixations. They suggest that an explanation of the occurrence of long fixations may be found in the content of the reading selection. In order to test this possibility, a study was made of

PLATE XXX



Effect of new and difficult words upon eye-movements. Six high-school subjects all fixations which were longer than 20 fiftieths of a second in the records of nineteen subjects. The readings of these nineteen subjects showed a total of 259 fixations which were over 20 fiftieths of a second in length. The selection which these subjects read contained ninety words. If the long fixations simply occurred at random there should be an average of 2.9 for each word in the paragraph. The number and duration of these long fixations, for each word in the selection, are given in Plate XXXI. This plate shows that three of the pauses occurred on the first word, "the," and that their duration was 38, 22, and 30 fiftieths of a second. Only one long fixation occurred on the word "two," three fell on the word "men," two on "were," etc. The point of interest in the plate is that the long fixations are not distributed in a random fashion with 2.9 falling on each word, but that they occur much more frequently on certain words than on others. The greatest number of long fixations fall upon the words "hyperaesthesia," "hypnagogic," and "hallucinations," these words receiving 31, 22, and 16 fixations respectively. Since these are the most difficult words in the paragraph, there can be no doubt that difficulty is one factor causing long fixation pauses. It will be noticed that thirteen words each receive as many as six or more of these long fixations. These words are underlined in the plate.

If the same cause operates to produce long fixations on all of the words, there must be some point of difficulty connected with the words receiving a larger number of such pauses. The word "consciousness" in the last line and the word "grew" following it appear to present difficulties. This is doubtless due to the fact that "consciousness" is not a common word to high-school pupils, and when used with "grew" it presents an idea which is difficult and unfamiliar. The phrase "objects need not" in the third from the last line presents familiar words in an unfamiliar combination. The whole quoted sentence contains a difficult thought, and by the time this phrase is reached the difficulties come to a focus. The fact that "objects" has the same form both as a noun and as a verb may add to the confusion. No explanation is offered as to why "namely" in the eighth line should receive six long fixations. In line 6 the word "further" is not as common with high-school pupils as the form "farther" which might account for the difficulty. In line 4 the words "began" and "read" both present tense difficulties. The word "began" is often confused with "begun." The word "read" is spelled alike for both present and past tense but is pronounced differently and often causes trouble in reading. No explanation is offered for the word "subject."

PLATE XXXI

The	two	men	were	seated	at	a	table	upon	which
38	20	21	20	28		21	23		23
22		21	23	28		27	25		20
30		21					20		20

many	books	and	papers	were	scattered.	The
35	35			21	44	28
26					22	21
23						27
36						
22						

older	man	turned	to	a	page	in	a	large	book	and
31	24	21		31	22		20			21
30	21	22		30			23			27
24	24	25								
20	20									
32	23									

began	to	read.	The	subject	of	the	chapter	was
20	22	24	20	34	22	22	21	22
22	36	28	22	23	22		20	
28		20		32				
21		21		32				
20		25		38				
20		30		23				
				24				

something	about	hypnagogic	hallucinations	and
		20-26-67-59	21-24-34-23	30
		20-29-31-22	23-34-25-53	
		21-24-42-42	32-26-21-43	
		23-29-32-20	20-22-28-23	
		25-29-21-23		
		24-43		

hyperaesthesia.	A	few	pages	further	on	he
34-34-22-25-29-24	56	28	20	24	24	
33-27-23-34-26-25	22	22		22		
74-36-23-21-35-29		21		20		
40-32-26-22-21-43		30		20		
23-21-24-45-25-32		52		20		
37				22		

Location of long fixation pauses, 19 subjects

PLATE XXXI*a*

came	to	a	sentence	which	read,	"One	thing,
24			21.	30 20 23 29	20	21 24	27 25

however,	is	obvious,	namely,	that	the	manner	in
20 24 21 26 30	31 23 26	24 31 21	22 29 26 23 24 22				

which	we	become	acquainted	with	complex
			20 20 22		20 20 27

objects	need	not	in	the	least	resemble	the
35-38 20-43 25-24 22-23	34-26 25-38 26-24 21	28 20 27 20 21 23 32	22	24	21 22	22 28 21	22 20

manner	in	which	the	original	elements	of	our
24		22		34 24 27	20 30 21		38 26 20

consciousness	grew	up."
25-24-23 39-40-22 20-57-23 20-22	93 29 21 30 26 24	27

PLATE XXXI—*Continued*

The results of this form of tabulation indicate that difficulty of material must have some relation to the length of fixations. No other explanation is apparent which could account for the fact that only six long fixations fall on the ninth line while thirty-one fall on the tenth.

A similar form of study was applied to the elementary pupils. Their records showed that long fixations were distributed over all the words of the selection. Apparently even simple words present difficulties to a child in the elementary school.

The interpretation of the foregoing data must be related to the development of reading habits. The records of the elementary subjects, whose reading habits are still immature, show that long fixations are frequent and occur all through the selection. Evidently long fixations are characteristic of immature types of reading. The high-school and adult subjects represent more mature readers. In general they have outgrown the long fixation habits. However, when words of special difficulty or difficult phrases are encountered, they return immediately to the primitive type of habits characteristic of the immature reader. Earlier in this chapter the same kind of a reversion to primitive reading habits was observed in the narrowing of the eye-voice span when difficult words were encountered.

The conclusion to be drawn regarding the long fixations is that width of eye-voice span is not a determining factor. The return to immature reading habits caused by encountering difficulties in the reading material is apparently a more adequate explanation.

CHAPTER IV

THE EYE-VOICE SPAN AND THE RECOGNITION OF MEANING

MATERIAL AND METHOD USED

The use of a photographic method gives the most accurate measure of the eye-voice span. The general use of this method is limited, however, by the very elaborate apparatus which is involved. It would be desirable to have a device which would give objective information regarding the eye-voice span without use of apparatus. Quantz, in his study cited in the introductory chapter, called attention to a fact which is of special significance. He suggested that certain words which are spelled alike but pronounced differently might be used to determine eye, voice, and meaning relationships. This chapter reports the testing of such a device by photographing the eye-movements which occur when such words are encountered in the reading.

A paragraph of twelve lines was constructed, which contained six words which are spelled alike but pronounced differently. The subjects were not informed that the paragraph was unusual in any respect, but were instructed to read it carefully in order to get the meaning. The subjects read orally and were not allowed to glance over the selection before beginning to read. The test passage used was as follows:

> The boys' arrows were nearly gone so they sat
> down on the grass and stopped hunting. Over
> at the edge of the woods they saw Henry
> making a bow to a little girl who was coming
> down the road. She had tears in her dress
> and also tears in her eyes. She gave Henry a
> note which he brought over to the group of
> young hunters. Read to the boys it caused
> great excitement. After a minute but rapid
> examination of their weapons they ran down
> the valley. Does were standing at the edge
> of the lake making an excellent target.

The test words in the paragraph are "bow" in line 4, "tears" in line 5, "tears" in line 6, "read" in line 8, "minute" in line 9, and "does" in line 11. The paragraph is so constructed that the meaning of these words is not evident until the next few words in the sentence are read. For example, in line 5, the word "tears" is ambiguous until the word "dress" is reached. The hypothesis in regard to the eye-voice span is that no error will be made in the reading if the span is wide enough to enable the reader to take in the word "dress" before pronouncing the word "tears." If the span is not wide enough to do this, there is a strong probability of error. By varying the distance between the test words and the part of the sentence which qualifies it, a rough measure of the width of the eye-voice span can be secured. If this hypothesis is correct, subjects having a wide eye-voice span should make fewer errors than those whose span is narrower.

The use of such a paragraph will also help to answer the question as to where the recognition of meaning occurs in the reading process. Does the recognition of meaning accompany the eye or the voice, or is it intermediate? A similar question could be raised in regard to silent reading.

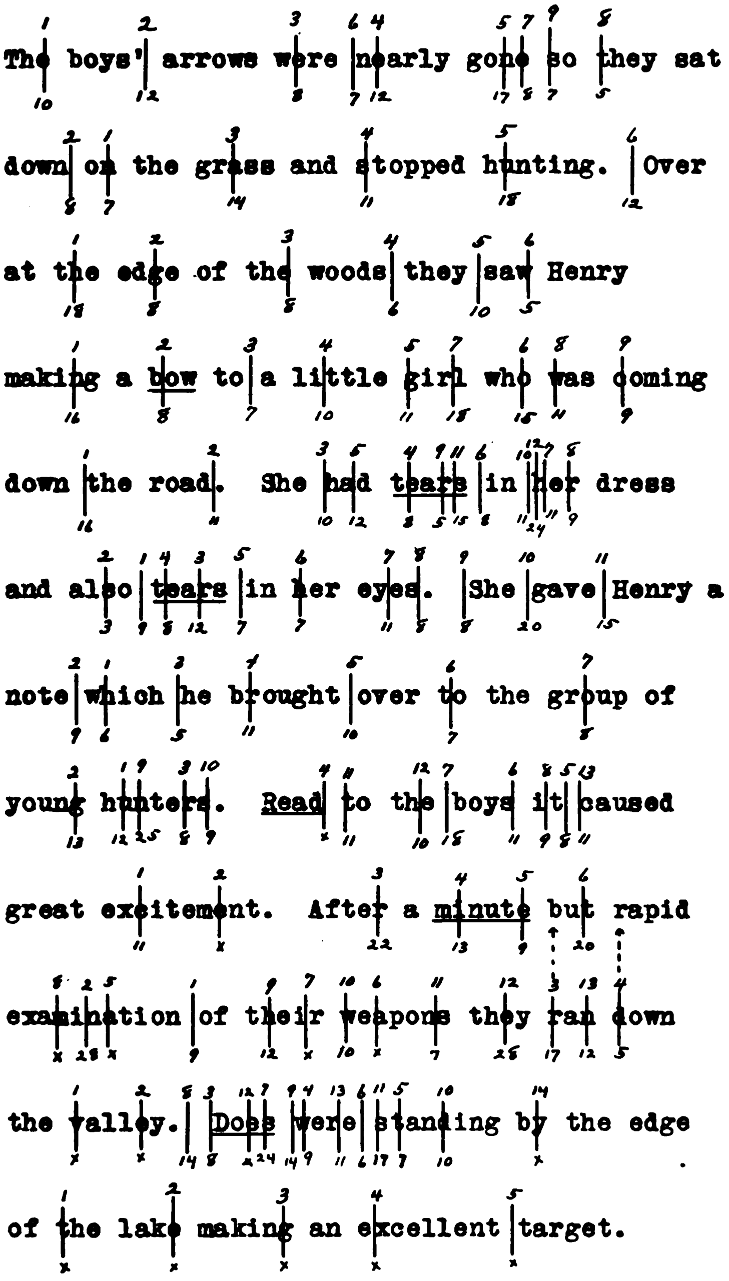
ORAL READING OF TEST PASSAGE

Photographs were made of the eye-movements of a number of subjects while reading this selection. A comparison of the behavior of the eye, when encountering one of the test words, with the dictaphone voice record will show how closely the two are related. Plates XXXII–XXXIV give the records of the oral reading of this selection by three subjects.

Plate XXXII gives the record of Subject H13, a good reader from the junior class. In the reading of the first line of the selection, a long regressive movement occurred at the sixth fixation, carrying the eye back over the word "nearly." The dictaphone record showed that he had trouble with this word, hesitating before pronouncing it and repeating the first syllable as follows, "nea – – nearly." The fact that the fifth fixation, the one just before the regressive movement, fell on the word "gone" would indicate that the eye had passed the word "nearly" but was recalled when the voice reached it. Evidently the eye did not fully recognize the meaning of the word when it fixated on it the first time, and the regressive movement occurred to make sure of the meaning.

The next difficulty which is evident in the record of this subject is found in the fifth line on the word "tears." This was one of the test

PLATE XXXII



The boys' arrows were nearly gone so they sat
down on the grass and stopped hunting. Over
at the edge of the woods they saw Henry
making a bow to a little girl who was coming
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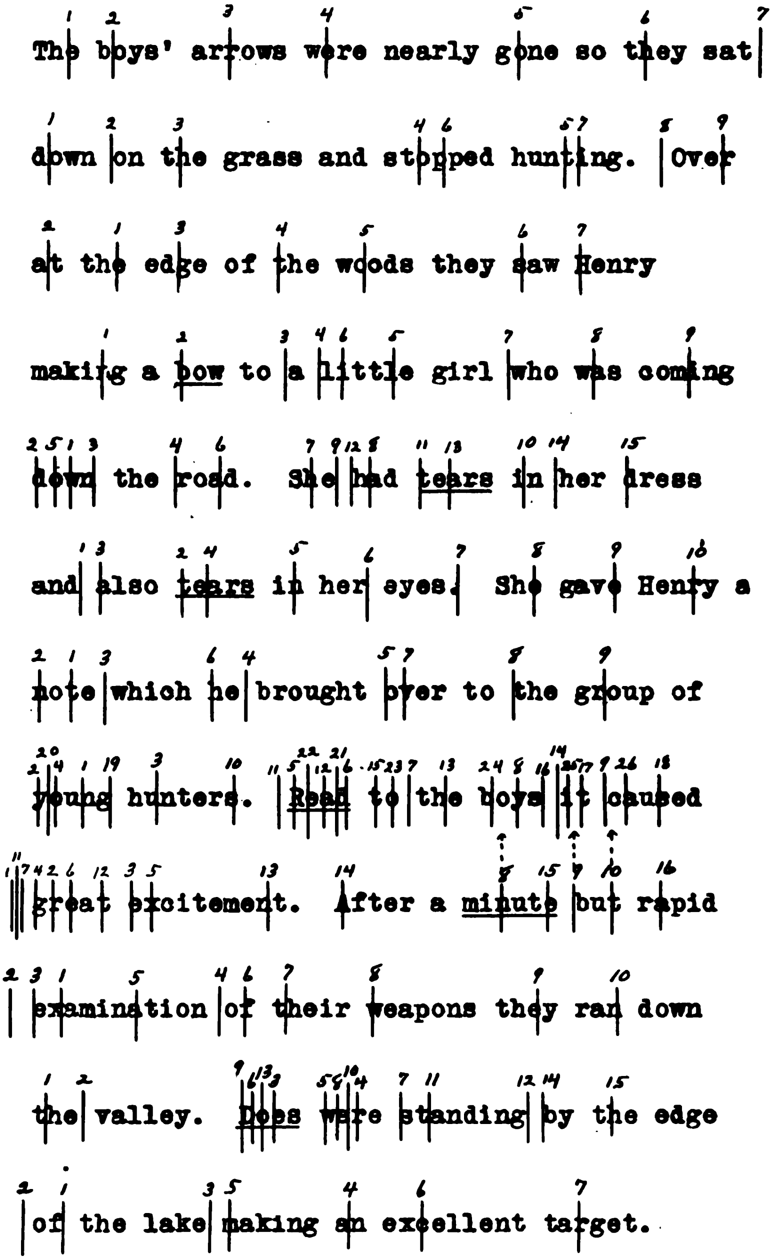
examination of their weapons they ran down
the valley. Does were standing by the edge
of the lake making an excellent target.

Oral reading of test passage by Subject H13

PLATE XXXIII



The boys' arrows were nearly gone so they sat
down on the grass and stopped hunting. Over
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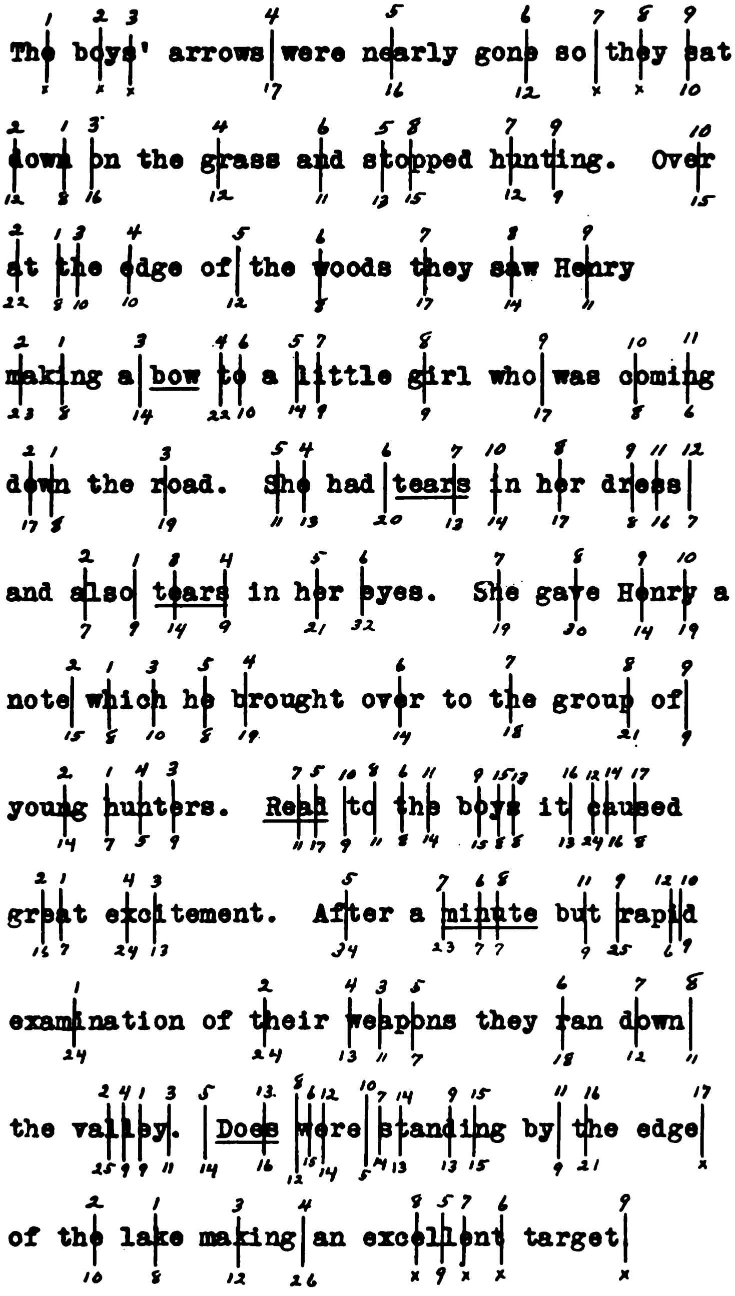
examination of their weapons they ran down
the valley. Does were standing by the edge
of the lake making an excellent target.

Oral reading of test passage by Subject A1

PLATE XXXIV



The boys' arrows were nearly gone so they sat
down on the grass and stopped hunting. Over
at the edge of the woods they saw Henry
making a bow to a little girl who was coming
down the road. She had tears in her dress
and also tears in her eyes. She gave Henry a
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young hunters. Read to the boys it caused
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of the lake making an excellent target

Oral reading of test passage by Subject A3 words and it caused the reader a great deal of trouble. The eye passed and returned to the word twice before the correct meaning was recognized. The dictaphone record read as follows: "She had – ah – tear (error) – – tears (correct) in her dress." The difficulty experienced is clearly reflected in the eye-movements. In line 6 the reader approached "tears" very cautiously and was successful in avoiding an error.

In the eighth line the word "read" caused a period of confusion for the eye. Following the eye-fixations in serial order, it will be seen that the difficulty did not appear until after the fifth fixation just following the word "it." The dictaphone shows that the voice proceeded to the word "it" before being fully aware of its error. The record was as follows: "Read (error) to – – read (error) to the boys – – – read (correct) to the boys it – –."

In the ninth line the word "minute" was mispronounced and left uncorrected. The voice repeated the phrase "but rapid" twice. The accompanying eye-movement may be seen in the third and fourth fixations of the next line. These fixations, as indicated by the dotted line, were regressive movements to the last two words of the ninth line.

In the eleventh line the voice made a very long hesitation before pronouncing "does," but succeeded in pronouncing it without error. The film record shows that the eye passed back and forth over the word several times before the meaning became clear. The subject had evidently become cautious and did not attempt to pronounce the word until the meaning was recognized.

Plate XXXIII gives the record of Subject A1, a college student ranked as a poor reader. A correlation between eye and voice difficulties appears here as in the case of Subject H13. The word "bow" in line 4 was mispronounced but was immediately corrected. The regressive movement from the fifth to the sixth fixation shows the location of the eye at the time of the readjustment.

The word "tears" in line 5 was mispronounced and passed without correction. The voice also repeated the word "had" just preceding "tears."

The voice had a very difficult time with the word "read" in the eighth line, repeating the phrase three times before reading it correctly. The reading was as follows: "– – – read (error) to – – – – – read (error) to the boys it caused – – – read (correct) to the boys – – – – – – –." The difficulty in eye-movements was fully as great, the eye making 26 fixations on the line. The confusion in eye-movements in the next line shows that the eye had made at least 10 fixations there before the reading was corrected. Fixations 8, 9, and 10 in line 9 were regressive movements back to the end of line 8.

The reaction to the word "does" in line 11 was a very long hesitation on the part of the voice, the word finally being pronounced without error. The fixations show that the eye was very busy during the pause and that it made a minute survey of both "does" and "were."

Plate XXXIV, showing the record of Subject A3, brings out the same kind of correlation between voice and eye difficulty. This subject made errors in pronouncing "bow" in line 4, "tears" in line 5, "read" in line 8, "minute" in line 9 and "does" in line 11. More or less confusion in eye-movements can be observed in all of these positions on the plate.

The records of these subjects make it very evident that certain characteristic confusions in eye-fixations accompany points of difficulty in oral reading. A comparison of the percentage of errors made in the reading of this selection with the eye-voice span as determined by the other part of this study would show whether any relation exists between width of eye-voice span and these same oral-reading difficulties.

TABLE XV

ERRORS IN WORD TEST PARAGRAPH—ORAL READING

Subject	Number Test Words in Passage	Number Correct	Number Errors Corrected	Number Errors Not Corrected	Average Eye-Voice Span
H4	5	3	0	2	10.0
H5	6	2	3	1	12.0
H6	6	1	4	1	12.4
H11	5	0	1	4	9.6
H12	5	3	1	1	13.7
H13	6	2	3	1	13.8
H14	6	4	0	2	17.6
H15	6	3	1	2	12.3
H16	6	4	0	2	8.5
H18	6	2	2	2	11.5
H19	6	4	1	1	12.8
H20	6	4	2	0	23.0
A1	6	2	2	2	12.2
A2	6	1	1	4	9.3
A3	6	1	2	3	13.6

Table XV gives the data for the reading of a selection containing this kind of test words by 15 subjects. The table shows the number of test words in the passage, the numbers pronounced correctly the first time, the number of errors which were corrected, the number of errors not corrected, and the average eye-voice span. Table XVI is made up from Table XV, and shows the relation of errors in the test paragraph

TABLE XVI

RELATION OF ERRORS IN WORD TEST PARAGRAPH TO EYE-VOICE SPAN

Number of Subjects	Test Score—Per cent of Words Correct and Corrected	Average Eye-Voice Span
1	1–20	9.6
1	21–40	9.3
2	41–60	11.3
6	61–80	12.6
5	81–100	14.8

to the eye-voice span. This table is based upon the percentage of test words in the paragraph which were pronounced correctly at first or were immediately corrected. It should be read as follows: One subject pronounced from 1 to 20 per cent of the words correctly and had an

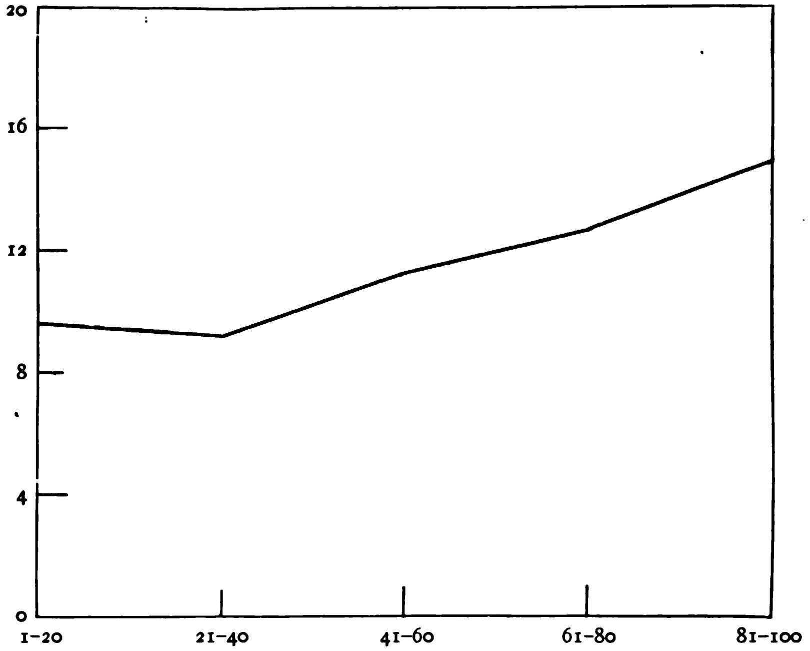


FIG. 12.—Relation of errors in word test paragraph to eye-voice span. Percentage of words correct shown on horizontal axis. Average eye-voice span on the vertical axis.

average span of 9.6 letter-spaces, one pronounced from 21 to 40 per cent correctly and had an average span of 9.3 letter-spaces, two pronounced from 41 to 60 per cent correctly and had an average span of 11.3 spaces, etc. The same data are shown graphically in Figure 12. A distinct positive correlation is evident between a wide eye-voice span and a high score in reading the selection. A subject with a wide span has an opportunity to interpret the meaning in larger units and is able to get the correct meaning before the voice reaches the points of difficulty.

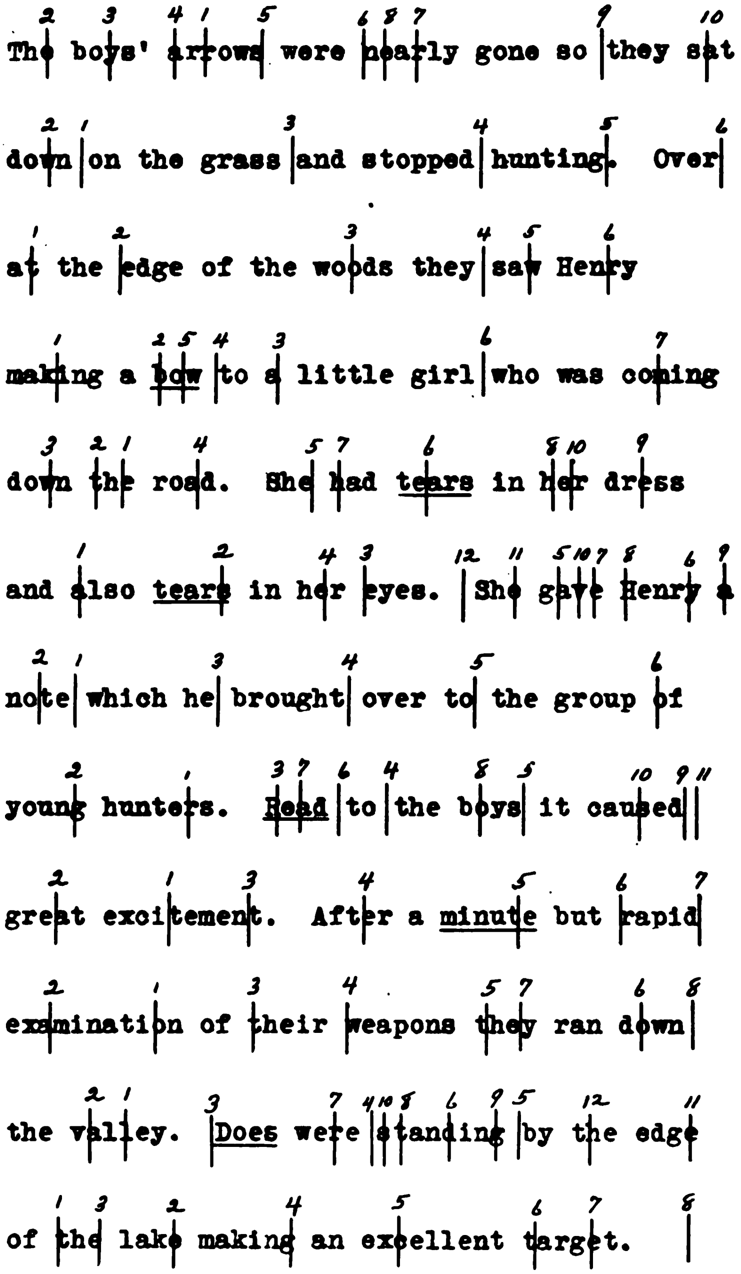
Two facts stand out clearly as a result of the use of the paragraph containing the test words. The first is that difficulties in the recognition of meaning are reflected in the character of the eye-movements. The second is that subjects with a wide eye-voice span have less difficulty with such material than do subjects with a narrower span. Whether the eye-voice span is a cause or an effect will need to be determined by a careful analysis of the development of reading. This question will be considered in the last section of this chapter.

SILENT READING OF TEST PASSAGE

The facts brought out in the oral reading of the test passage suggested that a comparison with silent reading might be of interest. With this purpose in mind, photographs were taken of the silent reading of the same passage by a number of subjects. Plates XXXV to XXXVII show the records of these readings. Plate XXXVI gives the silent-reading record of Subject H7, a good reader from the sophomore class. This subject made a great many fixations per line all through the selection, which was due to the direction to "read it carefully in order to get the meaning." The larger number in the first line shows the reaction of the eye to new material. Eye-movements for the first line of any selection are seldom characteristic of the movements for the selection as a whole. The reading of the next three lines shows that the eye had settled down to a rhythmic movement. Apparently the word "bow" in line 4 caused no difficulty.

In line 5 the word "tears" caused a break in this rhythmic movement but the correct meaning was evidently obtained without great difficulty. In the next line the word "tears" caused considerable disturbance, and several regressive movements were necessary. The word "read" in line 8 caused little trouble. In line 9 the word "minute" apparently created a great deal of difficulty. The eye behaved in the same manner in this as it did in the oral selections at a point where the voice had difficulty.

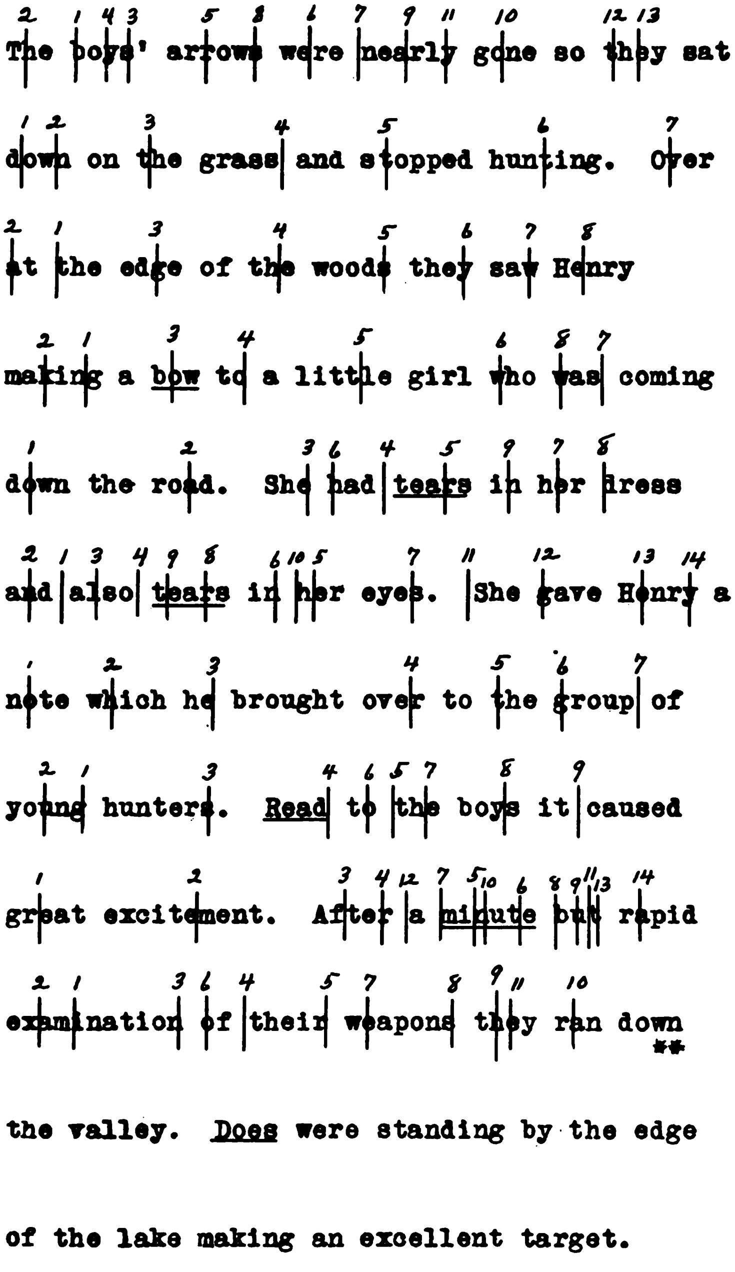
PLATE XXXV



The boys' arrows were nearly gone so they sat
down on the grass and stopped hunting. Over
at the edge of the woods they saw Henry
making a bow to a little girl who was coming
down the road. She had tears in her dress
and also tears in her eyes. She gave Henry a
note which he brought over to the group of
young hunters. Read to the boys it caused
great excitement. After a minute but rapid
examination of their weapons they ran down
the valley. Does were standing by the edge
of the lake making an excellent target.

Silent reading of test passage by Subject H3

PLATE XXXVI



The boys' arrows were nearly gone so they sat
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at the edge of the woods they saw Henry
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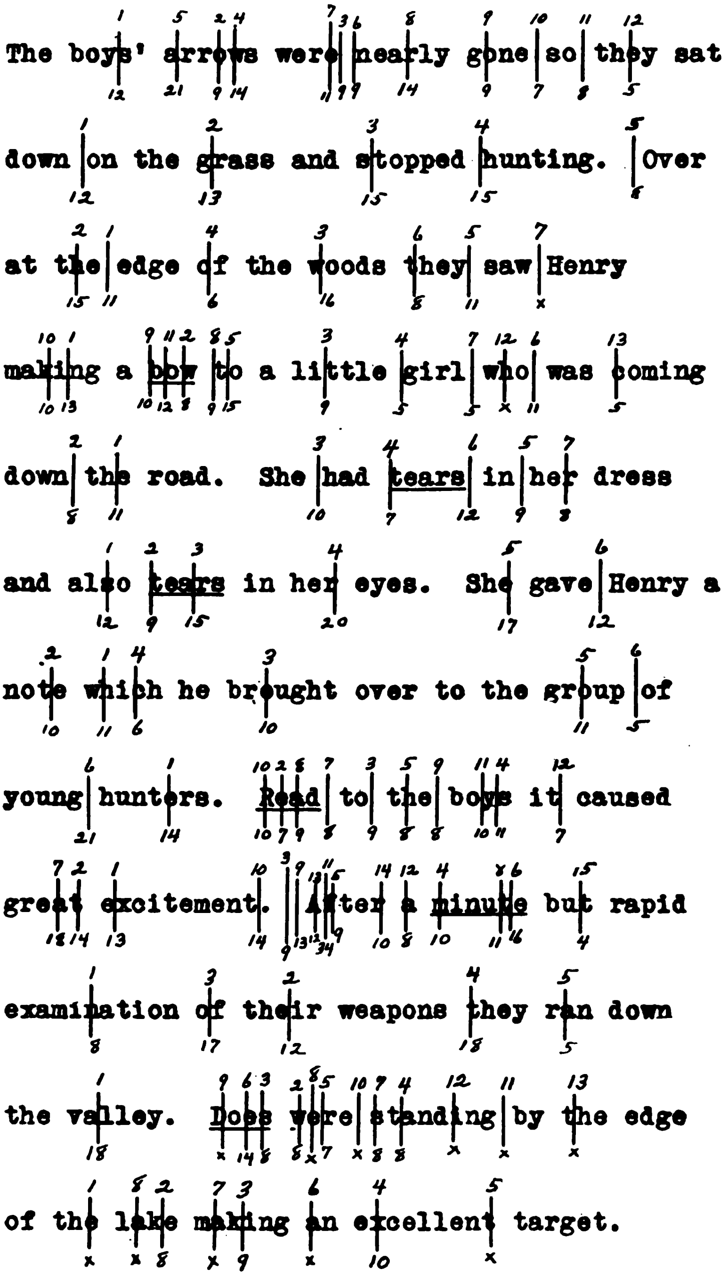
note which he brought over to the group of
young hunters. Read to the boys it caused
great excitement. After a minute but rapid
examination of their weapons they ran down **
the valley. Does were standing by the edge
of the lake making an excellent target.

Silent reading of test passage by Subject H7. (**—end of film)

PLATE XXXVII



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down on the grass and stopped hunting. Over
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making a bow to a little girl who was coming
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of the lake making an excellent target.

Silent reading of test passage by Subject A4

The record of Subject A4, a good reader from the college, is given in Plate XXXVII. This subject also shows a characteristic reaction to the first line of the selection, not falling into a rhythmic movement until the beginning of the second line.

The record of line 4 shows clearly that the word "bow" presents a difficulty. Evidently the wrong meaning was used at first and the eye returned to it several times before getting the correct interpretation. The word "tears" did not cause any marked disturbance in the reading. "Read" in line 8 and "minute" in line 9 each caused a radical change in eye-movement. The same kind of confusion occurs with these two words which, in the oral readings, accompanied a serious error in the reading. In line 11 the word "does" causes fully as much trouble as in any of the oral selections. This shows that the eye-movements in both oral and silent reading are largely controlled by the recognition of meaning.

THE RELATIONSHIP BETWEEN ORAL AND SILENT READING

The preceding sections have shown that the difficulties in both oral and silent reading are indicated by similar disturbances in eye-movements. The eye-movements are evidently more directly related to recognition of meanings than are the eye-voice spans. The reasons for this can be brought out more clearly if we review the development of reading from its early oral stages to the later and more mature stages of silent reading.

In a primitive or very immature type of reading the eye and voice proceed exactly together. The recognition of meaning also accompanies them. Progress at this stage is made a word at a time, or, if the word is too complex, progress is by shorter units, even letters. The attention span is so small that the eye does not move on until the voice has pronounced the word or syllable. In the case of words which are new to sight, but whose meaning is known when heard, the meaning is arrived at only by the sounding and pronouncing of the word. The oral pronunciation is a definite step in the recognition of meaning. A concrete example of such an eye-voice-meaning relationship is found in Plate VI, line 1. Here the reader is keeping his eye fixated upon the word while he is pronouncing it and getting its meaning. This pupil, who is a poor reader from the second grade, has a primitive, immature type of reading habit. Line 1 of Figure 13 represents graphically such a situation. The eye, *E*, the voice, *V*, and the meaning, *M*, keep very close together.

Plate VIII shows the record of Subject E7, a poor reader from the third grade, who keeps his eye an average of 8 letter-spaces ahead of his voice. This reader exhibits a little more complex type of reading habit. The attention span has developed until the meaning can be followed even though the eye is some distance ahead of the voice. In Figure 13 this pupil is represented by line 2. The eye is shown to be 8 letter-spaces ahead of the voice. Since this reader is still very immature and has a narrow eye-voice span it seems probable that he still relies on his oral pronunciation to get the meaning of his words, and for this reason the meaning, *M*, is located a little nearer the voice than the eye. As the student learns to read to himself the meaning attaches itself more closely to the position of the eye. Accordingly, in the other lines of Figure 13, *M* is located nearer the eye than the voice. The whole matter of the location of *M* in the figure is merely schematic since there is no objective evidence upon which an exact location can be based.

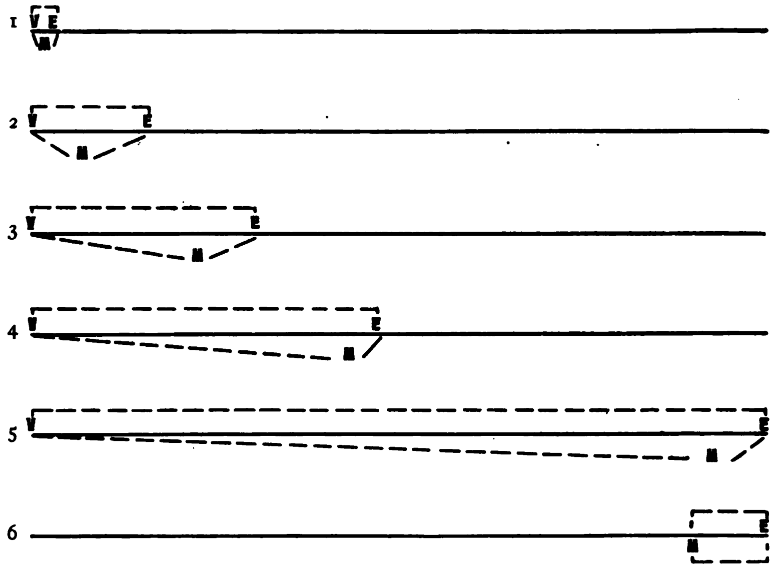

FIG. 13.—The development of the attention span in reading

The attempt to locate the position of *M* presents a very complex problem. Meaning itself is not a unitary and complete sort of thing which occurs instantaneously at certain points through the reading. After a reader has mastered his vocabulary, the recognition of the meanings of words, except in the case of new or difficult ones, doubtless occurs as soon as the eye perceives the words. The recognition of the meaning of words therefore might be said to keep pace with the eye. But the complete meaning of a sentence or a paragraph is not made up by summing together the individual meanings of the words. The meaning of each word in a sentence is modified by what precedes and follows. Phrases, clauses, or whole sentences are the units and the recognition of the complete meaning must be in a liquid state during the reading process, being subject to continual change and being held in the mind in a tentative fashion until the end of the unit of thought is reached. To speak of a location for the recognition of such a developing meaning as this would probably refer to the focal point in the moving conscious state or attention span by which the mind "carries on" in the reading process. That this focal point or the apex of the moving attention span would be nearer the eye than the voice is also indicated by the amount of conscious attention given to these two factors. The motor reaction of the voice ultimately becomes quite automatic. It follows along behind the eye at a distance such that the immediate memory association with the material perceived is kept intact but it is back in the margin of consciousness as long as no special difficulty is encountered. The principal part of the attention span is concerned with the new material which the eye is receiving, and with translating this into the meaning whole. Consequently the focus of attention is centered around the eye and the meaning, while the voice is largely left to pronounce the words automatically with a minimum amount of consciousness accompanying it.

The successive lines in Figure 13 represent increasing degrees of maturity of reading. Line 3 shows the record from Plate XXII of Subject H5, whose average eye-voice span is 12 letter-spaces. Line 4 shows the record from Plate XIV of Subject E22, whose average eye-voice span is 19.7 letter-spaces. Line 5 shows the eye-voice span of Subject H1 at a fixation in the next to the last line in Plate XXI*a*. At this point the reader's eye was 46 letter-spaces ahead of her voice, which indicates a high degree of maturity of reading habits.

The previous chapters of this study have pointed out that there is a close relationship between a good quality of reading and a wide eye-voice span. The question was raised as to which of the two is cause or effect. It would appear that both are effects, and that the causal element is the existence of a general attention span wide enough to hold a large number of words or reading elements in the mind at one time.

The preceding evidence shows that a poor, immature reader can hold only a few letters or words in the focus of attention, while more mature readers are the ones who have a wide attention span. Progress in reading would therefore be a matter of the development of the span of attention to such a degree that it would be possible for the eye to keep a considerable distance ahead of the voice and thus provide a wide margin for the interpretation of meaning. The extent to which such a span may be developed, or to which it is dependent on factors of native capacity, will need to be determined by further experimentation. The problem would seem to be worth a careful investigation through an elaborate training experiment.

It is an interesting fact to note that Subject H1, who at one point had a maximum span of 46 letter-spaces, reduced her span to 5 letter-spaces when the word "hallucination" was encountered. The same tendency to cut down the width of the span is evident whenever any difficulty is encountered. At such times the reader is placed in the same situation as a child, and returns at once to the same primitive type of eye-voice relationship which is characteristic of the habits of the immature reader.

The relation of oral to silent reading can now be shown more clearly. In such a case as that represented in Figure 13, line 1, the attention span for oral or silent reading would be the same, since the eye, voice, and recognition of meaning move along as a unit. As more mature reading habits are formed the nature of the attention span becomes different for the two processes. For oral reading it includes the eye and meaning and also in a lesser degree the voice which, because of the automatic character of its reaction, allows its conscious control to be much reduced in intensity. The silent-reading process is entirely relieved of any attention to the voice and the whole of consciousness can be focused upon the eye and the meaning. Such a situation is represented in Figure 13 by line 6. It cannot be assumed, however, that in silent reading the width of the attention span is limited to the space from the eye to the meaning. The general range of attention must cover the reading material by complete thought units, and in the silent-reading process the width of the attention span must be great enough to do this. When the reader cannot maintain a span sufficiently wide for this, he falls back into more primitive habits and pronounces the words to make the meaning clear.

It has been pointed out that when difficulties are encountered in oral reading the eye-voice span is immediately reduced to a primitive form. The same thing occurs in silent reading. When the difficult words in the test paragraph were encountered in silent reading, the eye returned to the word causing the difficulty, just as it returned to the position of the voice in oral reading. An example of such a case is shown in Plate XXXIII at the word "read" in line 8. Here the reader experienced a difficulty in interpretation of the meaning at that point, and the eye which has passed the word "boys," returned to the word "read," cutting down the span from the eye to the recognition of meaning to zero in the same manner as in oral reading. If the difficulty in getting the meaning in silent reading is sufficiently great, there is a reversion not only to the habit of bringing the eye back to the location of the recognition of meaning, but also to the most primitive habit of silently pronouncing the words. This reinstates the most primitive form of reading where the eye, the voice, and the meaning proceed together.

The development of the reading process may therefore be traced through three stages. First, the most primitive or immature stage of oral reading where the eye, the voice, and the meaning are all focused at the same point. Secondly, the more mature stage of oral reading where there is a considerable span between the eye and the voice, with the recognition of meaning occurring at a point nearer to the position of the eye. Thirdly, the stage of silent reading where the reader is entirely relieved of any attention to the voice and where the entire attention can be given to the eye and the meaning, making possible the development of a much higher degree of proficiency.

In chapter ii it was observed that some good readers in the fifth grade had an average eye-voice span greater than many high-school pupils. The fact that some pupils had developed such a wide span during the first four years of school would indicate a possibility that, with sufficient emphasis and appropriate method, a wider span could be developed with other pupils. The time for the teaching of oral reading is during the first four school years. By the time the fifth grade is reached the mechanics of reading should be mastered by the pupils and a larger amount of silent reading given. Figure 3 makes it clear that a great many pupils have not succeeded in developing a wide eye-voice span even at the high-school level. If the assumption is true, as the evidence indicates, that a wide eye-voice span is closely related to a wide attention span, and that a wide attention span is essential to good silent reading, it is highly important that a wider eye-voice span should be developed if possible during the first four years of school. It should be developed during these years, first, because that is the period during which oral reading predominates, and secondly, because the advantage of a wide attention span should be made available for silent reading by the beginning of the fifth grade.

The fact that the subjects from the freshman class of the high school showed a wider eye-voice span than the subjects from the sophomore and junior years was ascribed to the special training given to this class by the English department. Evidently there were some elements of method in the special training which affected the eye-voice span. These specific methods should be available for use in the first four school grades. The results of this investigation indicate that the development of the eye-voice span is a factor of sufficient significance, for both oral and silent reading, to warrant further research through a training experiment making use of specific methods having this end in view.

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HOW NUMERALS ARE READ

AN EXPERIMENTAL STUDY OF THE READING OF ISOLATED NUMERALS AND NUMERALS IN ARITHMETIC PROBLEMS

By
PAUL WASHINGTON TERRY

THE UNIVERSITY OF CHICAGO
CHICAGO, ILLINOIS

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CHAPTER I

INTRODUCTION

Numerous investigations in the psychology of reading and in the measurement of reading ability have developed a valuable body of scientific information about the methods of reading words and sentences of the ordinary kind, but the reading of numerals has had only occasional attention in these studies and that merely in an incidental way. Such work on reading as has been done in the field of arithmetic has concerned itself with isolated numerals rather than with numerals set in sentences or problems.

The present investigation is concerned with the reading of numerals both in separate lines and in the context of arithmetical problems. The first part of this report describes a series of studies, based on introspective observations, of some of the relatively definite and highly developed habits of graduate students in reading numerals both isolated and in problems. The second part of the report deals with this same class of readers and with the same kinds of reading materials, but employs objective methods.

For the first part of the report the data were obtained by recording introspective observations which were made by the subjects after they had read a set of arithmetical problems in which numerals occurred. The introspections were supplemented by directly observing and reporting the results of the reading of isolated numerals. The information secured in this preliminary work serves as a basis for the interpretation of the data obtained in the second part of the investigation in which photographic records of eye-movements were secured. The whole investigation is only an introduction to the study of the methods employed by children in their gradual acquisition of the power of reading numerals. This large genetic study was the original aim of the present investigation. The intricacies of the problem turned what was originally thought of as an introductory investigation into an elaborate detailed study. Yet educational implications are present even in this preliminary work. Through the study of adults, a body of facts has been discovered which throws light on methods of reading problems in arithmetic to which children must ultimately attain, whatever be the initial habits through which they pass in the course of their development.

PART I. PRELIMINARY STUDIES OF THE READING OF NUMERALS—BY INTROSPECTIVE METHODS

CHAPTER II

NUMERALS IN ARITHMETICAL PROBLEMS—FIRST PRELIMINARY STUDY

1. DESCRIPTION OF THE STUDY

For the first preliminary study seven simple arithmetical problems were used. These were so formulated that each included a set of from one to four numerals. The problems were so made up that while the numerals in each one were similar, those which were used in the different problems exhibited variations in length. The numerals in problems 1, 3, 5, and 6 are two in number in each case, but vary in digit-length from one to seven digits. Problem 2 includes a set of four numerals, each numeral being made up of from one to two digits; Problem 4 has four numerals made up of from three to four digits; and Problem 7 uses a familiar date and two numerals of exceptional character, namely 100 and 1000.

The problems which were used in the first preliminary study are as follows:

1. At 65 cents a dozen, what will 8 dozen eggs cost?
2. A man buys 5 tons of coal at 9 dollars a ton, and 3 cords of wood at 12 dollars a cord. What is the total cost of both of them?
3. A farmer owns one farm of 286 acres, and another of 1754 acres. How many acres does he own all together?
4. A wholesale grocer has 4375 cases of canned corn. To three customers he shipped 286, 2567, and 615 cases respectively. How many did he have left?
5. If electricity travels on a wire at the rate of 288,106 miles per second, how long will it take to travel 144,053 miles?
6. If one railroad uses 2,191,504 cross ties during the year, and another railroad 617,450 in the same period of time, how many more ties does the one use than the other?
7. During 1918 a citizen bought four $100 Liberty bonds, and two $1000 bonds. What is the total of the sum he invested in these bonds?

Ten graduate students of the School of Education of the University of Chicago were asked to solve all of the problems. They were instructed to work the problems rapidly and accurately, and with pencil and paper or without, as they preferred. They were urged to observe faithfully the arithmetic problem-solving attitude from the beginning of a problem to its solution. After the answer of each problem was recorded the subjects were asked to describe in detail their experiences while reading the problem with special reference to the numerals. After the first problem had been solved and the reading of its numerals described, the subjects began to note the kinds of experiences they were asked to observe. As a result they were able to give the desired description more promptly and easily with each successive problem. These were recorded and condensed into tables I–VI.

2. FIRST READING AND RE-READING DISTINGUISHED

The most obvious and general fact noted in the records of the several subjects was their clear and unmistakable differentiation of the reading of a problem into two definite and distinct phases differing in time and in purpose, namely, the first reading and the re-reading. Subsequent sections of the investigation emphasize the importance of this observation concerning the distinction between two phases of the reading of a problem. The general procedure of each subject was, first, to read the problem through "to get the sense" or "to see what was to be done with the numbers," and secondly, to re-read one or all of the numerals, and sometimes also a few of the accompanying words. These re-readings of the numerals were for such purposes as "verification" of their first reading, or the "cultivation of assurance" before copying the figures on paper for computation. The subject with one or two exceptions was not aware that he habitually followed such a procedure until he began to make introspective observations of his habits.

3. PARTIAL FIRST READING AND WHOLE FIRST READING OF NUMERALS

The knowledge gained during the first reading was found to be very different in different cases. Subjects sometimes perceived numerals as merely numerals; sometimes they noted only the first digit or the first two digits. At times they noted the number of digits but did not attend to any one in particular. Again they reported a numeral as large or as small, or as larger or smaller than some other numeral. Sometimes they noted its location in the typewritten line. Frequently two or more of these items were included in the general perception. In all such cases as have been described, the perception lacks detail and precision. It is evidently a kind of cursory preliminary recognition of the general character and setting of the numeral. Its value consists in the fact that it permits the subject to think about the problem without entering at first into the minute details of solution.

There were cases, however, even in the first readings, in which the subjects gave attention to the identity and place of every component digit. In addition these careful readers noted also the character of the numeral, observing whether it was a whole number or a decimal. They also gained a notion of the magnitude of the numeral as determined by the number of digits. With each of the subjects, cases were found in which the recognition was full and detailed. Such cases were recorded as "whole first readings." Any reading which fell short of complete detail was recorded as a "partial first reading."

The results of the introspections are given in full in Table I. Beginning at the top of the left-hand column, this table should be read vertically as follows: Problem 1 contains the two numerals 65 and 8, and these were read altogether a total of twenty times by the ten subjects. Of the twenty readings, three were partial first readings, sixteen were whole first readings, and one could not be classified.

TABLE I

PARTIAL FIRST READINGS AND WHOLE FIRST READINGS BY TEN SUBJECTS IN SEVEN PROBLEMS

	Problems							
	1	2	3	4	5	6	7	
Numerals given in problems	65	5	386	4375	288,106	2,191,504	1918	100
	8	9	1754	286	144,053	617,450		
		3		2567				1000
		12		615				
Total number of readings	20	40	20	40	20	20	10	20
Partial first readings	3	12	10	31	13	11	0	1
Whole first readings	16	28	10	9	7	9	10	19
Doubtful	1							

Examination of Table I shows that the numerals in problems 4, 5, and 6, which were all longer ones with three to seven digits, were read partially more than half of the times and accordingly have percentages of partial first readings of 50 or more. The numerals in problems 1, 2, and 7, on the other hand, were read wholly more than half of the times and have percentages of partial first readings of only 30 or less. The longer numerals are seen to have been read partially more frequently, while the shorter numerals are read in detail more frequently. Attention should be called at this point, however, to the fact that the whole first reading of a numeral does not necessarily mean that the numeral will not be re-read. On the contrary later discussions in this report will show that almost all numerals were re-read after the first reading, including even those which were read in detail during the first reading.

In order to bring out the relation between partial and whole readings and the character of the numerals, Table II was compiled. This table shows the ranks of the various numerals with reference to the frequency of partial readings. Percentages were calculated by dividing the number of times a numeral was partially read by the total number of readings of that numeral.

Among the longer numerals a greater digit-length appears to cause a large percentage of partial readings. Such a comparison between numerals of different lengths is significant when the same number of numerals is used in the various problems compared. Problems 3, 5, and 6 each have two numerals. The six digit numerals of Problem 5, and the six- and seven-digit numerals of Problem 6 were given respectively 65 per cent and 55 per cent of partial first readings. The three- and four-digit numerals of Problem 3, on the other hand, were given only 50 per cent of partial first readings.

TABLE II

RANKS OF NUMERALS ACCORDING TO PERCENTAGES OF PARTIAL FIRST READINGS

Ranks	Percentage of Partial First Readings	Description of Numerals	Numerals Read
1..................	77	Four three- to four-digit	4375; 286; 2567; 615
2..................	65	Two six-digit	288,106; 144,053
3..................	55	Two six- to seven-digit	2,191,504; 617,450
4..................	50	Two three- to four-digit	386; 1754
5..................	30	Four one- to two-digit	5; 9; 3; 12
6..................	15	Two one- to two-digit	65; 8
7..................	5	Two familiar	100; 1000
8..................	0	Date	1918

Of the numerals which were usually given a whole first reading, the date 1918 stands out as different in character from other numerals of like length. It is the only one which was never partially read. The very familiar numerals 100 and 1000 with the dollar sign attached were like the date for the most part, in that they were read partially only once. In this case, the partial reading was revealed by a mistake made by the reader—the numeral 100 was read as 1.00 instead of as 100.

The inclusion of several numerals in the same problem appears to induce a greater proportion of partial first readings. In Problem 4, where there are four numerals, the percentage of partial readings is 77, whereas in Problem 3, where only two numerals appear, the percentage of partial readings is only 50, although the numerals in both problems are of the same lengths. The explanation of this fact seems to be that the subject loses interest in the numerals when many of them appear together. Consequently he does not make the radical adjustments in rate of reading which would be necessary for the careful reading of a series of several numerals.

The validity of this explanation is supported by the results of another comparison of a similar type which can be made from the tables. The numerals in Problems 1 and 2 are all one or two digits in length. There are two numerals in Problem 1, and four in Problem 2. The percentage of partial readings in Problem 1 is 15, whereas in Problem 2 the percentage of partial readings is 30, or twice as great as that in Problem 1. In this comparison, as in that above, where four numerals of a certain digit-length appear in a problem, they were more frequently read partially than when only two such numerals appear.

The first numeral in a problem tends to be given a more careful and thorough reading than any of the other numerals in the same problem. The basis for this statement is found in the fact that in three of the four problems which employ the longer numerals, the first numeral receives a greater number of whole first readings than any of the numerals that follow. According to the original tabulations, the first numeral in Problem 5, 288,106, was given five whole first readings whereas the second numeral, 144,053, was given only two whole first readings. A similar preponderance of whole readings appears in favor of the first numeral in both problems 3 and 4. A comparison of the foregoing kind cannot be drawn, however, between shorter numerals, since they were almost invariably given whole first readings regardless of their position within the problem.

4. INDIVIDUAL SUBJECTS CLASSIFIED AS PARTIAL FIRST READERS AND AS WHOLE FIRST READERS

In Table III the ten subjects are arranged in order from left to right according to the number of their partial readings. They range from 14 partial first readings by G to no partial first readings by Subject H. The total in each case is 19 readings. G, Bl, and S show a significant preponderance of partial readings. H, T, D, and K, on the other hand, exhibit a preponderance of whole first readings, each of the latter showing 12 or more such readings out of a possible 19. These seven subjects can accordingly be classified into two groups as partial first readers and whole first readers. The partial readers read partially not only the three- to seven-digit numerals usually thus read, but also several of the other numerals which are usually read in detail. Similarly the whole readers read in detail not only the nine one- and two-digit numerals and the familiar numerals which are usually so read but also several of the other numerals which are usually read only partially.

TABLE III

Subjects Arranged according to Number of Partial and Whole First Readings

	Subjects									
	G	Bl	S	P	De	K	Ko	D	T	H
Partial first readings........	14	13	12	9	8	7	7	6	3	0
Whole first readings.........	5	6	7	10	11	12	11	13	16	19
Doubtful..................	......	......	......	......	......	......	1	......	......	......

Subjects Ko, De, and P are not so distinctly marked off as the seven discussed above. However, since they show a preponderant number of whole first readings, they may be classified as whole first readers. When they are so classified there are seven whole first readers and only three partial first readers. There were, therefore, more than twice as many whole first readers as partial first readers among the subjects of this study.

5. RE-READING OF THE SEVERAL NUMERALS

After the first reading of a problem it was left entirely to the choice of the subject whether he should or should not re-read the numerals in the problem. In all but a few cases, which are classified as "Doubtful," the reports of every subject show when he re-read any individual numeral. Table IV gives, for each set of numerals, the number of times they were

TABLE IV

Number of Re-readings

	Problems							
	1	2	3	4	5	6	7	
Numerals given in problems......	65	5	386	4375	288,106	2,191,504	1918	100
	8	9	1754	286	144,053	617,450	......	1000
	......	3	......	2567	....	....	......	......
	......	12	......	615	....	....	......	......
Number of re-readings............	11	38	20	39	17	20	0	13
Numerals not re-read............	9	......	......	1	1	....	10	7
Doubtful......................	......	2	......	......	2	....	......	......

re-read, the number of times they were not re-read, and the number of doubtful cases. Table V gives the ranks of the several sets of numerals according to the percentages of re-readings. The percentage of re-readings for any set of numerals was found by dividing the total number of re-readings which the numerals of the set received, by the total number of re-readings which it was possible for them to have received.

Examination of Table IV reveals the fact that the numerals of every set but one were very generally re-read. The longer numerals were re-read almost without exception. From Table V it is seen that the four sets of numerals from three to seven digits in length which are found in problems 3, 4, 5, and 6, received 85 per cent, 97.5 per cent, and 100 per cent, respectively, of the numbers of possible re-readings. In two cases only were numerals of this length reported as not re-read, and only two cases were reported as doubtful. Since there are ten ordinary numerals of three- to seven-digit lengths, it was possible for these numerals to have been re-read a total of one hundred times by the ten subjects. Of this number of possible re-readings the three- to seven-digit numerals actually were re-read ninety-six times.

TABLE V

RANKS OF NUMERALS ACCORDING TO PERCENTAGES OF RE-READINGS

Ranks	Percentage of Re-readings	Description of Numerals	Numerals Read
1.5	100	Two six- to seven-digit	2,191,504; 617,450
1.5	100	Two three- to four-digit	386; 1754
3	97.5	Four three- to four-digit	4375; 286; 2567; 615
4	95	Four one- to two-digit	5; 9; 3; 12
5	85	Two six-digit	288,106; 144,053
6	65	Two familiar	100; 1000
7	55	Two one- to two-digit	65; 8
8	0	Date	1918

Even the short one- and two-digit numerals and the familiar numericals were very generally re-read, although usually they had been given whole first readings. Each of these sets of numerals, with the exception of the familiar date numeral, was re-read 50 per cent or more of the possible times. The one- and two-digit numerals, in problems which contain only two numerals, were re-read 55 per cent of the possible times; but the numerals of this same length, in problems which contain four numerals, were re-read 95 per cent of the possible times. The familiar numerals with the dollar sign attached were re-read 65 per cent of the possible times. The only numeral never re-read is the familiar date 1918, which was not necessary in any way to the solution of the problem in which it appears.

6. RE-READING BY INDIVIDUAL SUBJECTS

The very large percentages of re-readings of the several sets of numerals imply that most of the individual subjects are persistent re-readers. Examination of Table VI, in which the facts for each individual subject are displayed, proves that such is the case. Subjects G, Bl, and S who had read most of the numerals only partially during the first reading, proceeded to re-read the numerals before they began to solve the problems. They re-read not only the numerals at which they had merely glanced the first time, but also those which they had read in detail at first reading. None of these three subjects showed a number of numerals not re-read equal to the number of numerals which he had read in detail at first reading.

TABLE VI

NUMBER OF RE-READINGS BY VARIOUS SUBJECTS

	Subjects									
	G	Bl	S	P	De	K	Ko	D	T	H
Number of re-readings	16	18	16	13	17	17	18	16	12	18
Numerals not re-read	3	1	3	6	1	2	1	3	5	1
Doubtful	.....	.....	.....	.....	1	.....	.....	.....	2	.....

The seven subjects who were classified as whole first readers re-read practically as many of the numerals as the partial first readers. Subject H, who gave all of the numerals a whole first reading, re-read as many numerals as any partial first reader. The smallest numbers of numerals re-read are found in the records of the whole first readers, T and P. These same subjects have the largest numbers of numerals not re-read. Besides the familiar numerals and the one- and two-digit numerals, T did not re-read the numeral 4375 and P did not re-read 288,106.

At this time attention should be called to the fact, which will be elaborated in chapter viii, that the re-reading of numerals appears to be very closely connected with copying them on paper for computation. With rare exceptions the subjects, when solving the problems of this study, followed the procedure of copying the numerals and computing with pencil. In the chapter referred to above, however, it was found that several subjects, including G and H of the present study, solved the problems which were read in the second part of the investigation "mentally" and directly from the text. Such subjects when solving problems "mentally" did not re-read the numerals.

After each subject had solved all of the problems, he was asked to describe any individual attitudes or previous experiences which he believed had affected in an important way his methods of reading numerals in arithmetical problems. Three of the subjects gave descriptions which threw light upon their procedures as reported above. Subject T stated that he has had from his early school days unusual ability in retaining by visual memory both long and short numerals which he had read. This ability had recently undergone intensive training in the form of much reading and copying of army serial numbers, which his work as company clerk in the army required. He believes his habit is to read numerals in detail wherever he sees them, and that he could have solved perhaps all of the seven problems immediately after the first reading without looking at the numerals again. He goes on to say, however, that notwithstanding his careful first reading of the numerals, he is in the habit of re-reading them before beginning computation "in order to be sure."

Subject H, who gave every numeral a whole first reading, states that early difficulties with arithmetical problems caused him to develop habits of great caution in reading and solving them. He describes his procedure as beginning with a careful, complete reading of every numeral in a problem when he first comes to it. He then returns to re-read every numeral and sometimes some of the words.

Subject G, whose record presents the largest number of partial first readings of the numerals, reports that he intends to obtain "only a general idea" of the numerals from the first reading, especially if they are long ones. He explains that he chose this attitude toward the numerals after he had learned through experience that he was unable to recall them for computation and "had to go back for them anyhow."

7. SUMMARY

A summary of the results of the first preliminary study on how numerals in arithmetical problems are read includes the following points:

1. The subjects distinguished two phases in the reading of problems, namely, a first reading and a re-reading. The purpose of the first reading is to discover the conditions of the problem, while that of the re-reading is to perceive the numerals accurately for use in computation.

2. Two ranges of perception of numerals during the first reading are distinguished, namely, whole first reading and partial first reading.

3. Shorter numerals and very familiar numerals more frequently receive whole first readings, whereas longer numerals more frequently receive partial first readings.

4. The first numerals in problems which have numerals of three to seven digits in length, are commonly given whole first readings.

5. When as many as four numerals appear in a problem they receive a greater proportion of partial first readings than in those cases in which only two numerals of the same digit-length appear.

6. Subjects differ widely in their habits. Some are predominantly whole first readers, others are partial first readers.

7. Numerals of all lengths and types, when they are used in computation, are very generally re-read for computation.

8. All subjects persistently re-read numerals when they begin to use them in computation.

CHAPTER III

RANGE OF CORRECT RECALL OF NUMERALS AFTER THE FIRST READING—SECOND PRELIMINARY STUDY

I. DESCRIPTION OF THE STUDY

The purpose of the second preliminary study was to obtain further information as to the nature of the readings of the numerals during the first reading of a problem. The general plan followed for the accomplishment of this purpose was to have the subjects report all of the details of the numerals, which they were able to recall immediately after the first reading.

The subjects were seven graduate students in the School of Education of the University of Chicago. Of the seven subjects, only one, Subject G, had served in the first preliminary study. The materials which they read were twelve simple arithmetical problems similar to those used in the first preliminary study. Six of the problems were work problems in the sense that each of them was worked until an answer was found. No questions, however, were asked concerning the numerals of these problems. Their function was to help the subjects maintain throughout the study the problem-solving attitude by actually solving problems. The readings of the other six problems were the bases of the data which were used in the study. In the context of these problems a total of sixteen numerals varying in length from one to seven digits was included. Two or three numerals were placed in each of five of the problems. In Problem D, however, four numerals appeared together. Numerals of similar length were placed in the same problem, as was done in the problems of the first preliminary study. All of the problems were presented in typewriting.

The problems which were read for data are as follows:

PROBLEM A

At 43 cents a dozen, what will 2 dozen eggs cost?

PROBLEM B

If a man buys 5 tons of coal for 45 dollars, what will he have to pay for 8 tons?

PROBLEM C

A farmer owns one farm of 246 acres, and another of 1754 acres. How many acres does he own altogether?

PROBLEM D

A wholesale merchant had on hand 1000 cases of canned corn. From three factories he bought 1276, 91 and 718 cases respectively. How many did he then have?

PROBLEM E

If one railroad uses 2,981,534 cross ties during the year, and another railroad 617,453 in the same period of time, how many more ties does the one use than the other?

PROBLEM F

If one man can do a piece of work in 10 days, and another can do the same work in 9 days, what should be the wages of the second, if the wages of the first are 3 dollars?

The subjects were informed that they would be expected to solve most of the problems, but that they would be interrupted in their procedure in some of them by the placing of a cardboard screen over the text which was being read. They were told that they would not be informed beforehand as to which problems were to be solved and which were to be covered with the screen. Accordingly they were urged to maintain their normal problem-solving attitude toward every problem that was presented.

The time chosen for the placing of the screen, when it was to be used, was the moment when the subject completed the first reading of the problem. The subjects were therefore instructed to signal by a slight movement of the left hand the moment at which they were completing the first reading. This they were able to do without embarrassment after a brief training period with practice problems. The screen was used only with those six problems that carried in their context the numerals which were to be studied.

Immediately after the screen was placed over one of these problems the subject was asked to give in detail all of the items of the numerals which he could recall. After having proceeded in this manner with the first problem which was to be studied in this way, the subject understood what kinds of details concerning the numerals were desired, and with subsequent problems easily and promptly gave such of the details as he could recall.

The results are reported in tables VII and VIII under five classifications. The classification, complete, signifies that every digit of the numeral was recalled in its true identity and place. The second classification includes correct recall of the digit-length of the numeral and the identity and place of at least its first two digits. The third classification includes correct recall of the digit-length and the identity of the first digit; and the fourth classification includes correct recall of the digit-length of the numeral. The fifth classification includes those cases in which the subjects were able to recall nothing more of a numeral than its presence in the problem.

2. RANGE OF RECALL OF THE SEVERAL NUMERALS

The range of correct recall from the first readings of each individual numeral is displayed in Table VII. The point which stands out most strikingly after a survey of the table is that almost invariably some item from the first reading of every numeral is correctly recalled. A glance at the "totals" column at the extreme right shows that some item of the numerals in 94 of the 103 total number of readings was recalled. In five cases only, the numeral was not even "merely noticed." Such frequency of recall implies that in the minds of subjects confronted with arithmetical problems to be solved the numerals hold a place of unique significance among the other elements of the problems, and in consequence are noticed almost invariably.

TABLE VII

RANGE OF CORRECT RECALL OF NUMERALS FROM FIRST READING OF PROBLEMS

	One- and Two-Digit Numerals									Three- to Seven-Digit Numerals									All Numerals
	Problem A		Problem B			Problem F			Problems A, B, F	Problem C		Problem D				Problem E		Problems C, D, E	
Numerals read in problems	43	2	5	45	8	10	9	3	....	246	1754	1000	1276	91	718	2,981,534	617,453	....	....
Total number of readings given each numeral by all subjects	7	7	7	7	7	6	6	6	53	6	6	6	6	6	6	7	7	50	103
Range of correct recall of numerals: Complete	5	6	6	6	7	6	6	6	48	6	1	5	1	0	1	0	0	14	62
First two digits and digit-length	5	..	..	6	..	6	..	..	17	6	4	5	3	0	1	1	1	21	38
First digit and digit-length	6	6	6	7	7	6	6	6	50	6	5	5	4	2	1	6	3	32	82
Digit-length	6	6	6	7	7	6	6	6	50	6	6	5	6	4	3	7	7	44	94
Merely noticed	1	0	0	0	0	0	0	0	1	0	0	1	0	0	2	0	0	3	4

The range of recall which most frequently follows this habitual notice of the numerals also stands out clearly from this table. This item is the correct digit-length of the numerals. It was recalled from a very great majority of the readings, namely, from 94 of the total 103 cases. All of the exceptions occur in Problem 4 where four numerals of three different digit-lengths occur. In such a situation it was an easy matter for the length of one numeral to be confused with that of another. Evidently the number of digits in a numeral is a point of exceptional interest to the readers. This is not difficult to understand in view of the fact that the number of digits in a numeral is certainly one of the most highly significant indications of its value.

With the shorter numerals, complete recall was achieved in almost every instance. In the left-hand section of Table VII it is shown that such is the case in 48 instances of a total of 53. Apparently no greater demands were made upon the attention of the subjects by the reading of one- and two-digit numerals than practically all of them were both able and willing to meet. It is also apparent that the effort which was habitually used in reading the short numerals so firmly fixed them in memory that they were able to be recalled completely.

The longer numerals on the contrary do not exhibit such large preponderances in the higher ranges of recall as are exhibited by the shorter numerals. In comparatively few instances the longer numerals were completely recalled. The explanation is believed to be due to two facts: first, that longer numerals according to common experience are more difficult to recall than shorter numerals; and second, that in most cases the longer numerals were only partially read during the first reading of the problems.

When reading the longer numerals the subjects evidently gave more emphatic attention to the first one or two digits than to any other digits. In more than half of the cases the first digit was recalled, and in slightly less than half of the cases the first two digits were recalled. In only three instances were three or more digits retained, when recalls of the familiar numeral 1000 and of the numeral 246, which is found in the peculiar place of "first" numeral in Problem C, are excepted. The chief explanation of this greater emphasis on the first digits probably lies in the general habit of attacking printed matter from the left. It is also possible that the adult subjects of this study had learned empirically the greater value of the first digit of a numeral and its greater significance to the solving of the problem, and therefore had formed the habit of paying special attention to it when reading problems.

The first numeral of a problem seems to receive more careful attention during the first reading than any of the other numerals in the problem. More details of the first numeral are correctly recalled than of other numerals. Such a comparison can be made between the longer numerals only, because, as has been pointed out in previous paragraphs of this study, the shorter numerals almost invariably—and therefore quite without regard to position in the problem—are read closely enough for complete recall. The longer numerals appear in problems C, D, and E. In each of these problems more details of the first numeral are recalled. Problem C will serve as an illustration. Here the first numeral, 246, is completely recalled in all cases, while the second numeral is so recalled only once. In Problem D the numeral 1276 is considered the first numeral rather than 1000 because of the peculiar character of the latter numeral. The higher ranges of recall of first numerals are probably due in part to the advantages of "initial" position. By virtue of this position they would tend to be more vividly impressed upon the memories of the readers. In additon to this advantage it appears probable that the adult subjects of this study have learned empirically to pay greater attention to the first numeral. By so doing they would be able to make special use of it, not only in determining the conditions of the problem, but also as a base in reaching decisions concerning the relations of the numerals to each other.

The peculiar quality of the familiar numeral 1000 again distinguishes it from other numerals of the same length. In every case but one it was recalled completely. This single exception was due to an unusual case of confusion on the part of the subject, which caused him to forget even the sense of the problem.

3. RANGE OF RECALL—BY THE SEVERAL SUBJECTS

Certain subjects recall much more of the numerals than others. The significant differences between them occur in the higher ranges of recall and with the longer numerals. These differences are displayed in detail in Table VIII. The several individuals divide themselves into two general groups according as they reported relatively many or

TABLE VIII

VARYING RANGES OF CORRECT RECALL OF THREE- TO SEVEN-DIGIT NUMERALS BY THE SEVERAL SUBJECTS

	SUBJECTS						
	Hb	R	Bak	Th	L	G	C
Number of numerals read by subjects	8	8	8	4	8	6	8
Range of correct recall of numerals:							
Complete	4	2	2	2	2	1	1
First two digits and digit-length	7	4	4	2	2	1	1
First digit and digit-length	7	7	6	3	3	2	4
Digit-length	8	7	8	4	5	5	7
Merely noticed	0	1	0	0	1	0	1

relatively few of the longer numerals in the higher ranges of recall. Subjects Hb, R, Bak, and Th are included in the first group, and L, G, and C constitute the second group. The contrast between Hb of the first group and G of the second is striking. The former completely recalls half of the longer numerals and the first two digits of seven of the eight longer numerals read, while the latter recalls completely only one longer numeral and the first two digits of only one.

Differences between the two individuals in first-reading attitudes seem to account for the large differences exhibited by them in the ranges of recall. Subject Hb is a pronounced whole first reader. He intends to "grasp" all of a numeral when he first reads it. Subject G, on the other hand, is a striking example of the type of partial first readers. His purpose during the first reading, in so far as the numerals are concerned, is to obtain only a "general idea."

4. FURTHER EVIDENCE AS TO THE PURPOSE OF FIRST READING

Further evidence is found in this study in support of the conclusion presented in the first preliminary study that the main purpose of the first reading is to find the conditions of the problem in order to know how to proceed with solving. In nearly all instances the subjects in this study were able to indicate a correct procedure for the solution of any problem after the first reading. They were able to do this even in the many instances where they could recall nothing more of the numerals than their digit-lengths.

5. ITEMS OF RECALL NOT INCLUDED IN THE CLASSIFICATIONS

The classification scheme used in this study does not include every item concerning the numerals which was reported. In many cases subjects reported correctly the line of the problem in which a numeral appeared. In several cases they recalled its approximate location within the line. No items incorrectly recalled are included in the classifications. Several such items were reported. In general they followed the types of errors which would be found in any study of errors in the reading of numerals in arithmetical problems.

6. SUMMARY OF CONCLUSIONS

The results of the second preliminary study on the range of correct recall of numerals after first reading may be summarized as follows: (1) Some item of almost every numeral is recalled. (2) The digit length of numerals is recalled almost invariably. (3) The shorter numerals and the familiar numeral 1000 are completely recalled almost invariably.

(4) The first one or two digits of longer numerals are recalled in a majority of cases. (5) The first numeral, in problems which include numerals of the greater lengths, is more frequently recalled than any other numeral in the problem. (6) The subjects divided themselves into two groups according as they recalled in the higher ranges large or small proportions of the longer numerals. (7) Further evidence appears in support of the previous conclusion that the main purpose of the first reading of a problem is to learn its conditions.

CHAPTER IV

ANALYSIS OF THE RE-READING OF NUMERALS IN ARITHMETICAL PROBLEMS—THIRD PRELIMINARY STUDY

I. DESCRIPTION OF THE STUDY

The distinction was drawn between the first-reading and the re-reading phases of the reading of arithmetical problems in the first preliminary study. The general purpose of re-reading as stated was "to perceive the numerals accurately for computation." The present study was designed to give further description of the purposes of the subjects and of their activities with the numerals during the re-readings. The general method which was used to obtain the data was that of introspective observation on the part of adult readers.

The readers were four graduate students in the School of Education of the University of Chicago. One of them, Subject S, had read the problems of the first preliminary study. None of the others served as subjects in any other study of the investigation. They were asked to solve the five simple arithmetical problems which were later used as reading materials in the eye-movement studies and which are described in detail in chapter vi. Each subject was given pencil and paper and told that he might use them in solving the problems or not use them, as he chose. Before the beginning of the experiment the subjects were informed concerning the first-reading and re-reading phases of the reading of problems. At the conclusion of the experiment each of the subjects was of the opinion that his reading of arithmetical problems habitually followed these phases, and that the information given concerning them had not caused him to vary from his normal procedure.

The subjects were instructed to attack each problem immediately when it was presented and to proceed with it in accordance with their normal problem-solving attitude. They were to press a conveniently placed telegraph key at the instant of beginning to read and continue the pressure throughout the first reading. Immediately at the conclusion of the first reading the key was released. Thereafter whenever the attention of the subject was directed to the re-reading of any item from the text of the problem, the key was pressed and held, until attention was directed away from the text whereupon the key was immediately released. The effect of this practice was to secure a separate record for each of the one or more acts of re-reading from the text of a problem.

Every pressure and release of the key was recorded on a smoked-paper record sheet which was moving on two kymograph drums. The duration of each pressure on the key was measured in seconds by the use of a chronometer which was so placed that its marker recorded the time intervals on the record sheet side by side with the records from the key. A brief period of training with practice problems in this procedure was necessary in order to enable the subjects to follow the procedure correctly and easily. Immediately after the solving of a problem, and with its text before them for reference, the subjects were asked to report the words or numerals in the text of the problem, upon which their attention was directed at each separate re-reading. This they were able to do with promptness and certainty. The reports of the subjects and the time records from the kymograph are presented in tables IX and X.

The reading of Problem 2 by Subject Ba will serve as an illustration of the experimental procedure. Ba began to read the problem immediately when it was placed before him and at the same moment he pressed the key. The instant he finished the first reading of the problem, which required a time interval of 7.6 seconds, he released the key. Without delay he turned his attention to the numeral 357 in the text of the problem and immediately pressed the key. During an interval of 1.4 seconds he re-read this numeral. He then directed his attention to the sheet of paper on which he intended to copy the numeral and at the same time released the key. When 357 was copied he turned his attention to the numeral 1643, pressing the key at the same instant. During an interval of 2.4 seconds he re-read this numeral. When the re-reading of 1643 was completed he looked to the copy sheet to copy the numeral and at that moment released the key. This done, once more he glanced at the problem, simultaneously pressing the key, and fixed his attention upon the last sentence for .2 of a second. At the conclusion of this interval he released the key and was ready to proceed with solving the problem.

The numerals or words read at each re-reading from the problems are given for every subject in Table IX. The time in seconds required for re-reading the numerals or words is given under the numerals or words in every case. Beginning at the top of the table the first left-hand column reads that two re-readings were given to items from Problem 1 which contains the numerals 47 and 2. The item from the text of the problem which was read by the first re-reading was the numeral 47, and the duration of this re-reading was 2.4 seconds. At the second re-reading the numeral 2 was read and the time required for this second re-reading

TABLE IX

Numerals and Words Read at Each Re-reading Together with Number of Seconds Required

	Problems															
	1		2			3			4				5			
Numerals read in problems......	47 2		357 1643			243,987 21,765			1000; 1276; 91 817				1,918,564; 617,453			
Ordinal number of re-readings....	1	2	1	2	3	1	2	3	1	2	3	4	1	2	3	4
Subject Ba																
Numerals and words read......	47	2	357	1643	last sentence	243,987	21,765	......	all of numerals		whole problem	......	1918	564	617	453
Number of seconds required....	2.4	2.4	1.4	2.4	0.2	4.0	4.0	......	3.0	8.0	7.6	......	4.6	1.2	4.0	2.6
Subject Gl																
Numerals and words read......	47	2	357	1643	......	243,987	21,765	......	1000	1276	91	817	1,918,564	617,453	......	......
Number of seconds required....	0.6	0.2	1.0	1.0	......	2.0	1.4	......	1.0	1.6	2.6	1.0	1.8	3.2	......	......
Subject S																
Numerals and words read......	......	......	357 1643	......	......	243	987	21,765	1276	91	817	......	1918	564	617,453	......
Number of seconds required....	......	......	1.4	......	......	1.4	1.0	1.2	1.2	1.0	0.8	......	1.6	1.6	0.8	......
Subject Wm																
Numerals and words read......	......	......	357 1643	......	......	243,987	21,765	......	"three" and last 3 numerals	1000	last 3 numerals		1,918,564	617,453	......	......
Number of seconds required....	......	......	4.2	......	......	4.0	3.4	......	6.4	2.2	0.8	0.6	5.2	1.6	......	......

was again 2.4 seconds. The sum of the durations of the two re-readings from the problem, i.e., the total re-reading time for the problem was, therefore, 2.4 seconds+2.4 seconds or 4.8 seconds. This last detail of information appears in Table X, in the first left-hand column, and in the upper row.

2. OBJECTS AND NATURE OF THE RE-READINGS

The point which stands out most clearly in Table IX is that numerals were the objects of the re-readings almost invariably. Only three instances appear in the entire number of re-readings in which the objects of the re-readings were words. It is also clearly apparent that the numerals of the problems were almost invariably re-read. In five instances only, numerals were not re-read.

These facts serve as additional evidence in support of the conclusion, which was drawn in a previous section, that the numerals are of a nature which clearly distinguishes them from the other contextual elements of arithmetical problems and which causes them to make unusual demands upon the attention of readers.

Further light is thrown upon the procedures of subjects with the numerals by a review of the original reports. These reports show that every numeral which was re-read was copied on the computation paper immediately after it was re-read. In all of these cases paper and pencil were used in solving the problems. In such cases copying the numerals is one of the earlier moves in the total process of solving the problem. Re-reading the numerals appears in most cases to have been a necessary step preliminary to copying them. It is, therefore, proper to speak of such re-reading as re-reading for copying.

The number of readings which was required for the re-reading of a numeral for copying was usually one. Numerals varying in length from one to seven digits were thus re-read at one reading. To none of the numerals of one- to four-digit lengths was more than one re-reading given. To several of the six- and seven-digit numerals, on the other hand, two re-readings each were given. In these cases the first three or four digits of the numeral were re-read and copied as a group, after which the remaining three digits were re-read and copied as a second group. In two instances, the two numerals of Problem 2 were copied from one re-reading.

3. DURATION OF RE-READINGS

The duration of the first reading and the sum of the durations of the re-readings are given for the reading of each of the several problems by each of the individual subjects in Table X. Examination of the data shows that numerals of greater lengths required greater total re-reading times than numerals of lesser lengths. The total re-reading time in the data for each individual subject increases gradually, in most cases, from the relatively small total time required to re-read the short numerals of Problem 1 to the relatively greater time required to re-read the long numerals of problems 3 and 5. The numerals of Problem 4, which offers four numerals for re-reading, received in most cases a greater total re-reading time than the numerals of any other of the five problems, none of which offers more than two numerals for re-reading.

TABLE X

NUMBER OF SECONDS REQUIRED FOR FIRST READING AND FOR RE-READING OF PROBLEMS

Problems	1	2	3	4	5
Numerals read	47 2	357 1643	243,987 21,765	1000; 1276 91; 817	1,918,564 617,453
Subject Ba—					
First reading time	2.4	7.6	7.4	10.4	9.4
Total re-reading time	4.8	4.0	8.0	18.6	12.4
Subject Gl—					
First reading time	2.0	4.6	6.6	5.8	6.8
Total re-reading time	0.8	2.0	3.4	6.2	5.0
Subject S—					
First reading time	1.8	4.2	7.0	12.8	6.6
Total re-reading time	....	1.4	3.6	3.0	4.0
Subject Wm—					
First reading time	3.8	5.6	10.6	20.0	10.8
Total re-reading time	....	4.2	7.4	10.0	6.8

The total re-reading time of a problem is in most cases shorter than the first reading time of the problem. The obvious explanation lies in the comparatively small amount of work to be done during the re-reading. At this time as a rule the numerals only are included in the reading, whereas during the first reading all of the contextual elements of the problem, both words and numerals, are included.

4. SUMMARY

The following conclusions may be drawn from this study: (1) The objects of the re-readings from the problems were almost invariably numerals. (2) The numerals were re-read for copying on the computation sheets. (3) One re-reading for copying was sufficient for most of the numerals. Some of the longer numerals, however, were re-read in two parts. (4) The numerals of greater length required longer times for re-reading, on the part of a majority of the subjects. (5) The total time required for re-reading the numerals was less than the time required for the first reading, with three of the four subjects.

CHAPTER V

READING NUMERALS IN COLUMNS—FOURTH PRELIMINARY STUDY

I. DESCRIPTION OF THE STUDY

The purpose of this study was to give some description of the reading of numerals, when numerals only appeared as the material to be read and when each individual numeral was placed in a separate line. The general plan followed in procuring the data was to have adult subjects copy numerals from the pages on which they appeared onto other sheets, and at the same time articulate the numerals in an easy natural way. This articulation was recorded by the author of this report. By means of a system of notes which will be described later, it was possible to get a fairly full account of what was said and, as experience in making the records accumulated, it was possible to distinguish clearly the various types of reading.

The subjects were four graduate students in the School of Education of the University of Chicago. Subjects R, L, and G had each served in the second preliminary study. Subjects G and H had read the problems of the first preliminary study and photographic records of the eye-movements of both H and G appear in the second part of this report. The materials which they read were forty-eight ordinary whole numerals varying in length from one to seven digits, and including seven numerals for each different digit-length except that there were only six numerals of seven-digit length. Punctuation in the form of commas was used in the customary way with some of the five-, six-, and seven-digit numerals; and with some of these numerals it was not used. Four numerals of both the five- and six-digit lengths, and three numerals of the seven-digit length were punctuated, while three numerals of each of the five-, six-, and seven-digit lengths were not punctuated. The numerals were typewritten on separate lines and so arranged that the tens, hundreds, etc., places of the numeral above were not exactly above the same places of the numeral in the line below. Subjects R and G each read the whole set of numerals twice, while the other two subjects read each set only once.

The subjects copied the numerals from the text sheet on to the copy sheet at normal speed. At the same time they articulated the numerals in an easy low voice which the observer was able to hear at a distance of approximately two feet. That part of the instructions which called for copying the numerals was inserted in order to provide a genuine working purpose for reading them. At the same time this purpose required an exact reading of every numeral. The kind of reading done, therefore, in compliance with these instructions was of a relatively clearly defined functional type, quite similar in obvious ways to the re-reading of numerals for copying, which was described in the preceding study. The provision for articulation enabled the observer to report the readings in so far as the grouping of the digits of the numerals and the numerical language used in reading them were concerned. At the same time the articulation did not seem to interfere with the reading.

Numerals are said to be read by digit groups when certain successive digits are so closely associated with each other in the reading as to form units of reading, which units are at the same time clearly distinguished from other similar units. The digits which constitute a group are bound together by being pronounced in quick succession as one series. The pronunciations of the several digit groups are separated from each other by time intervals distinctly longer than the time intervals which separate the pronunciations of the individual digits.

For reporting the digit groups and the numerical language used in reading the numerals a simple code system was devised which was based on the symbols 1, 2, and 3 signifying respectively the grouping of the digits of a numeral in groups of one, two, and three digits. A few other signs were necessarily added to indicate various modifications of these groups. A brief period of training with sets of practice numerals was undergone by the observer and by each of the subjects. After this training, they were able to proceed with the experiment in full conformity with the instructions. The data which were obtained during the course of this study are arranged in tables XI–XV.

2. GENERAL DESCRIPTION OF THE THREE MAIN GROUPS USED

The most striking feature of the reading of numerals, which was discovered in this study, was the fact that the subjects habitually divided the numerals into digit groups. Three different sizes of groups were clearly distinguished in the readings, namely, those that were made up of one, two, and three digits respectively. The one-digit groups appeared more frequently in the one-, three-, and seven-digit numerals as is shown in Table XII. The two- and three-digit groups appeared in the readings of numerals of all the greater digit-lengths. Relatively large numbers of three-digit groups appear in readings of the five-, six-,

TABLE XI

Main-Group Patterns Used in Reading One- to Seven-Digit Numerals in Columns

	Digit-Length of Numerals																							
	1		2		3		4		5					6					7					
		F		F		F		F	Punctuated		Non-Punctuated		T F	Punctuated		Non-Punctuated		T F	Punctuated		Non-Punctuated		T F
										F		F			F		F			F		F	
Main-group patterns........	1	42	2	42	1-2	25	2-2	34	2-3	24	2-3	15	39	3-3	24	3-3	8	32	1-3-3	16	1-3-3	4	20
																					2-2-3	4	5
					3	17	1-3	2			2-2-1	1	1			2-2-2	9	9	2-2-3	1	3-1-3	1	1
																					1-2-2-2	2	2
											1-2-2	2	2			1-2-3	1	1			2-1-1-3	1	1
							"one thousand"	6													2-1-1-2-1	1	1
																					2-2-2-1	2	2
																			1-2-1-3	1			1
																					3-2-2	1	1
																					3-4	1	1
																					1-2-1-2-1	1	1

F, above, heads columns in which the frequency of appearance of the various main-group patterns is given.
T F, above, heads columns in which the total frequency of appearance of main-group patterns in both punctuated and non-punctuated numerals is given.

and seven-digit numerals. In the cases of the six- and seven-digit numerals the explanation of this condition lies in the fact that numerals of these lengths present just twice as many opportunities for the employment of three-digit groups as numerals of four- or five-digit lengths. In the case of the five-digit numerals, on the other hand, the large number of three-digit groups is attributable to the remarkable uniformity with which the habit of reading five-digit numerals in two groups of two and three digits respectively was followed by all of the subjects.

The three-digit groups exhibited two distinct types which are referred to as the simple and complex types. The three digits of the simple type of three-digit groups are pronounced individually and with equal time intervals between them. The three digits of the complex type on the other hand are pronounced in two distinct subgroups, the first of which includes one digit and the second, two digits. Both types appear in the readings of the five-, six-, and seven-digit numerals, as is seen in the readings of Subject G, which are reported in detail in Table XIV.

Habit on the part of the individual subject appears as the most conspicuous factor in determining which of the two types of three-digit group was chosen, when a three-digit group was used. The last right-hand column of Table XIII discloses the fact that Subject H used the simple type of three-digit group only, while Subject G used it in a preponderant number of cases. On the other hand Subject R used the complex type almost invariably.

3. MAIN-GROUP PATTERNS FOR NUMERALS OF LIKE LENGTH

It became apparent early in the course of this study that the digits of numerals of any one length were being grouped in much the same way by all of the subjects. This observation is strikingly confirmed by the data which are presented in Table XI. The fact that appears most strikingly after an examination of this table is that the digits of numerals of any particular length are divided into a certain number of groups, which groups are made up of certain numbers of digits and stand in a certain order of succession. The case of the seven-digit punctuated numerals will serve for illustration. The digits of these numerals are seen to have been divided into three groups by all of the subjects. In the first group, one digit is found almost invariably, in the second group three digits, and in the third group three digits. To this succession of digit groups of certain sizes only one exception occurs. Such an arrangement of the digits of a numeral is designated as a main-group pattern.

The one- and two-digit numerals were each read as single groups of one and two digits respectively. The first variation from one main-group pattern as representative of the reading of numerals of the same length occurs in the three-digit numerals, which exhibit two patterns.

TABLE XII

Number of One-, Two-, and Three-Digit Groups Used in Reading Numerals of the Several Digit-Lengths in Columns

	Digit-Length of Numerals						
	1	2	3	4	5	6	7†
Number of readings given numerals.	42	42	42	36*	42	42	36
Number of:							
One-digit groups..............	42	....	25	2	3	1	35
Two-digit groups..............	....	42	25	68	45	28	30
Three-digit groups............	....	....	17	2	39	65	51

* There are 36 readings of four-digit numerals when the 6 readings of the numeral 1000, which was always read as "one thousand," are omitted.

† One four-digit group was used by Subject L in reading one of the seven-digit numerals.

TABLE XIII

Number of Simple (3) and of Complex (1–2) Three-Digit Groups Used in Reading Five-, Six-, and Seven-Digit Numerals in Columns

	Digit-Length of Numerals								
	5		6		7		5–7		5–7
	Punctuated	Non-Punctuated	Punctuated	Non-Punctuated	Punctuated	Non-Punctuated	Punctuated	Non-Punctuated	Punctuated and Non-Punctuated
Subject R—									
Simple three-digit groups.........	......	......	5	......	7	......	12	......	12
Complex three-digit groups.......	8	6	11	12	5	10	24	28	52
Subject G—									
Simple three-digit groups.........	6	2	13	2	6	3	25	7	32
Complex three-digit groups.......	2	3	3	......	5	......	10	3	13
Subject H—									
Simple three-digit groups.........	4	2	8	......	6	2	18	4	22
Complex three-digit groups.......	......	......	......	......	......	......	......	......	......
Subject L—									
Simple three-digit groups.........	1	1	5	3	2	2	8	6	14
Complex three-digit groups.......	3	1	3	......	3	......	9	1	10

The four-digit numerals appear almost invariably in a pattern of two groups of two digits each. A conspicuous exception to this regular main-group pattern of the four-digit numerals is found in the familiar numeral 1000 which was regularly read as "one thousand." This exception is further evidence of the fact, to which attention has been called in other sections of this report, that this numeral is different in quality from other numerals of the same length.

The five-digit numerals show in a preponderant number of cases a pattern of two groups of two and three digits respectively. The dominant pattern for the six-digit numerals is that of two groups of three digits each. The first main-group patterns made up of three groups to appear among punctuated numerals are found in the seven-digit numerals. When numerals of any of the greater digit-lengths are written without punctuation, other patterns than the main-group pattern for that digit-length make their appearance. In the case of non-punctuated, seven-digit numerals as many as ten different main-group patterns were found. With all of the other digit-lengths, however, conformity to main-group pattern is clearly the rule with all subjects. Evidently such arrangements of the digits of numerals, when they are being read for copying, are procedures which have been very thoroughly conventionalized by long practice, or else such procedures rest closely upon certain fundamental laws of mental action.

4. VARIATIONS IN NUMERICAL LANGUAGE

The fact that all numerals of a certain digit-length were usually read in the same main-group pattern does not mean that the language used in reading them was the same. Variations in language were found in the readings of both two- and three-digit groups. By the use of symbols to represent each of these variations, the detailed numerical language which was used by one subject, namely by Subject G, is given in Table XIV for the readings of all the numerals. The patterns which appear in this table may, therefore, be designated as numerical-language patterns.

Four different numerical-language patterns are found in the readings by Subject G of the punctuated numerals of five-digit lengths. Any five-digit numeral may be pronounced according to each of these patterns. The numeral 76,184, which was one of the numerals read by the subjects, may be taken as an example of the five-digit numerals. When this numeral is pronounced successively according to each of the four numerical-language patterns, as they are represented from top to bottom in the column of punctuated five-digit numerals, the following four different pronunciations result: "seventy-six—one eight four"; "seven six—one, eight four"; "seven six—one eight four"; "seventy-six—one, eighty-four."

TABLE XIV

Numerical Language Patterns Used by Subject G in Reading Numerals in Columns

	Digit-Length of Numerals									
	1	2	3	4	5		6		7	
					Punctuated	Non-Punctuated	Punctuated	Non-Punctuated	Punctuated	Non-Punctuated
Number of numerals read	14	14	14	14	8	6	8	6	6	6
Numerical language patterns	1	2a 2b	1–2a 1–2b 3b	2a–2a 2b–2b "one thousand"	2a–3b 2b–(1–2b) 2b–3b 2a–(1–2a)	2a–3b 2a–(1–2a) 2a–2a–1	3b–(1–2a) 3b–3b (1-2b–1-2b)	3b–3b 2a–2a–2a 2b–2b–2b	1-(1-2a)(1-2a) 1–3b–3b 1–(1–2a)–3b 2b–2b–3b	2a–1–1–3b 2a–2a–3b 2a–1–1–2a–1 2a–2b–3b 2a–2a–2a–1

Symbols 1, 2, and 3 represent digit groups of one, two, and three digits respectively.

The letter "a" indicates that a digit group is pronounced as one word, i.e., "2a" when representing the numeral 76, indicates that it is pronounced "seventy-six."

The letter "b" indicates that each digit in a digit group is pronounced as a separate word, i.e., "2b" when representing the numeral 76, indicates that it is pronounced "seven six."

The dash, –, separates digit groups.

Parentheses () enclose the two subgroups of complex three-digit groups.

The symbol 1–2a, when representing (any three-digit numeral such as) 694, is pronounced "six, ninety-four."

A second examination of the four numerical-language patterns, the pronunciations of which are presented immediately above, reveals the fact that all four of the patterns are modifications of one fundamental main-group pattern. This fundamental pattern contains two groups, the first of which is a two-digit group, while the second is a three-digit group. It is the variations that appear in the pronunciations of both of these groups that distinguish the four different numerical-language patterns. In the two-digit groups the differences in language are merely those between the words, "seven six" and "seventy-six," or again between "eight four" and "eighty-four." In the three-digit groups the words used to pronounce the simple type differ from those used to pronounce the complex type, as "one eight four" differs from "one, eighty-four."

The habits of individual subjects were discovered in a previous paragraph to be the most conspicuous factors in determining which of the two types of three-digit groups was used. The original records show that such individual habits similarly were the chief factors in determining what language was used in pronouncing the two-digit groups. On the other hand, the fundamental main-group pattern for any length of numeral appeared consistently in the readings of all subjects. It is, therefore, apparent that the selection of the digit-length of groups and the selection of the order of their appearance are more fundamental phases of the reading of the numerals than the selection of the particular type of three-digit group and the choice of the particular words by which the two- and three-digit groups are to be pronounced.

5. INFLUENCE OF PUNCTUATION ON THE GROUPING OF DIGITS OF LONGER NUMERALS

Great differences appear between the readings of punctuated and non-punctuated numerals in the number of both two- and three-digit groups which are employed. Punctuation apparently has the effect of increasing the number of three-digit groups used, and conversely of decreasing the number of two-digit groups. In the extreme right-hand column of Table XV it is seen that each of the last three subjects used a much greater proportion of three-digit groups for the punctuated numerals, and on the other hand a much greater proportion of two-digit groups among the non-punctuated numerals.

The preponderance of three-digit groups in the punctuated numerals and conversely the preponderance of two-digit groups in the non-punctuated numerals are each relatively much greater for the six- and seven-digit numerals than for five-digit numerals. Such a situation may be partly explained by the fact to which attention was called above, that it is possible to use just twice as many three-digit groups in reading a six- or seven-digit numeral as in reading a five-digit numeral. Fewer main-group patterns appear in the columns for punctuated numerals in Table XI than in the columns for non-punctuated numerals. Examination of the patterns in both columns shows that there are greater numbers of groups in the non-punctuated patterns, and this is due mainly to the more frequent use of the smaller group of two digits.

The readings of one subject, R, exhibited practically no differences in selection of two- and three-digit groups, which may be attributed to punctuation. With the larger numerals he used three-digit groups consistently, wherever it was possible to use them, in both punctuated and non-punctuated numerals. The exception in this case is probably attributable to his having attained to a relatively high stage of proficiency in the mechanical processes of reading numerals by means of a large amount of special practice in a kind of reading of numerals which is very similar to that used in this study. This practice he had gained while earning his living in the capacity of railroad rate clerk. A large part of his work was to read numerals and call them off to a colleague, who copied them on other paper.

TABLE XV

Effect of Punctuation on the Number of Two- and Three-Digit Groups Used in Reading Five-, Six-, and Seven-Digit Numerals in Columns

	Digit-Length of Numerals							
	5		6		7		5–7	
	Punctuated	Non-Punctuated	Punctuated	Non-Punctuated	Punctuated	Non-Punctuated	Punctuated	Non-Punctuated
Subject R—								
Two-digit groups......	8	6	....	....	....	3	8	9
Three-digit groups.....	8	6	16	12	12	10	36	28
Subject G—								
Two-digit groups......	8	7	....	15	2	12	10	34
Three-digit groups.....	8	5	16	2	11	4	35	11
Subject H—								
Two-digit groups......	4	4	....	9	....	8	4	21
Three-digit groups.....	4	2	8	....	6	2	18	4
Subject L—								
Two-digit groups......	4	4	....	4	1	4	5	12
Three-digit groups.....	4	2	8	3	5	2	17	7

The easy use of larger digit groups seems to give greater facility and greater speed to the reading of numerals. The value of punctuation to the subjects in large part lies in the fact that its employment encouraged the use of the larger group of three digits. The subject confronted with the necessity of reading a large but unknown number of unspaced digits is in a difficult situation. Such situations are not frequently encountered in the experiences of the ordinary reader. In consequence he proceeds with caution and with the smaller groups of one and two digits. The great number of small groups and the large number of group patterns which were employed in the readings of non-punctuated numerals of seven-digits length, as shown in Table XI, are evidently results of procedure under difficulty and with uncertainty. The same situation produced the great number and variety of numerical-language patterns in the readings by Subject G of the same numerals. In situations such as these, employment of the symbols of punctuation appears to afford great and immediate relief.

6. PERSISTENCE OF PATTERNS FROM THE FIRST READING THROUGH A SECOND READING

Opportunity to study the persistence of the main-group and numerical-language patterns, which were found in the first reading of the numerals, through the second reading of the same numerals was given in the cases of two subjects. Subjects R and G each read all of the numerals at two separate readings. The interval of time between the two readings was approximately 30 minutes with each subject. It was found that both R and G read the same numerals in the same patterns at both readings with very few exceptions. Subject R, who was more highly trained in the reading of numerals than any other subject, made fewer changes than G. More changes were made in numerical-language patterns than in main-group patterns. Most of the changes, which were made, were found in the non-punctuated numerals of seven-digits length.

The fact that the same main-group patterns so consistently reappeared at the different readings of these subjects gives further evidence in support of the conclusion, which was advanced in a paragraph above, that the arrangement of digits in main-group patterns has been very thoroughly conventionalized, or else that such procedure rests closely upon certain fundamental laws of mental action.

7. SUMMARY OF CONCLUSIONS

The following conclusions are drawn from the data presented in this study concerning the articulated reading of numerals for copying. (1) The digits of numerals are grouped in the process of reading. The groups of digits are of three sizes, namely, of one, two, and three digits respectively. (2) The numerals of each of several digit-lengths are read almost invariably in a main-group pattern which is peculiar to that digit-length. (3) Various numerical-language patterns are used in pronouncing numerals of the same length. (4) The employment of punctuation with the longer numerals encourages the use of three-digit groups and, conversely, discourages the use of two-digit groups in the reading. A larger group unit is thus secured. (5) The main-group and numerical-language patterns which are used in the first reading of numerals persist for the most part through a second reading of the same numerals.

PART II. STUDIES OF THE READING OF NUMERALS—BY USE OF PHOTOGRAPHIC APPARATUS

CHAPTER VI

DESCRIPTION OF THE EYE-MOVEMENT STUDIES

1. APPARATUS DESCRIBED

The data which are presented in the remaining sections of this report were obtained through the use of an apparatus designed to record the movements of the eyes in reading by means of photography. The apparatus is described and its use explained in a monograph by Dr. C. T. Gray,[1] and excellent photographs and diagrams of the same are found in a magazine article by Gilliland.[2] A few slight adaptations of the apparatus and procedure, which are described in these references, were necessary in view of the materials and purposes of the present investigation. The materials which were read by the subjects of this investigation were printed on separate cards eight and one-half by four inches in size. These cards were placed on the stand immediately before the lenses of the camera and directly before the eyes of the readers. A flood of light reflected from the overhead mirror gave bright illumination to any materials which were placed upon the stand. A convenient elbow-rest was provided for the right arm in such a manner that computation with a pencil could be undertaken easily and comfortably, and directly upon the problem card, whenever the subject chose to do so. With this arrangement it was possible for the pencil of light which is reflected from the eye, to register continuously upon the film during periods of computation, as well as during periods of reading from the problem.

2. THREE TYPES OF READING-MATERIALS USED

The reading-materials which were selected for this part of the investigation were of three different types, namely, simple arithmetical problems, numerals isolated in lines, and a paragraph of ordinary expository prose.

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[1] C. T. Gray, "Types of Reading Ability as Exhibited Through Tests and Laboratory Experiments," *Supplementary Educational Monographs*, Vol. I, No. 5 (1917), pp. 83–91.

[2] A. R. Gilliland, "Photographic Methods for Studying Reading," *Visual Education*, Vol. II, No. 2 (February, 1921), pp. 21–26.

The arithmetical problems were so designed as to provide a simple and genuine problem-setting for the numerals which had been selected for further study. The numerals thus selected included representatives from each of the several lengths of from one to seven digits, the familiar numeral 1000, and a group of three numerals placed closely together in one problem. Further details concerning the problems are given in Table XVI and the problems exactly as they were read by the subjects appear as Selection 1.

TABLE XVI

Description of the Five Problems Read in the Photographic Apparatus

Number of Problem	Ordinal Number of Each Line in Problem	Length of Line in Millimeters	The Number in Each Line of					
			Words	Letters	Numerals	Digits	Words and Numerals	Letters and Digits
1..........	1st	76	9	34	2	3	11	37
2..........	1st	95	11	40	1	3	12	43
	2d	88	8	37	1	4	9	41
3..........	1st	95	11	44	0	0	11	44
	2d	102	7	34	2	11	9	45
	3d	86	9	37	0	0	9	37
4..........	1st	95	10	42	1	4	11	46
	2d	102	8	56	0	0	8	56
	3d	90	8	30	3	9	11	39
5..........	1st	95	8	40	1	7	9	47
	2d	102	10	43	1	6	11	49
	3d	94	12	45	0	0	12	45
Total for all problems..	12	....	111	482	12	47	123	529
Average number per line	....	93.33	....	....	....	....	....	....

Note.—The number of spaces between words is not counted.

SELECTION 1

Five Problems Read before Photographic Apparatus

1. At 47 cents a dozen what will 2 dozen eggs cost?

2. A timber man owns one plot of 357 acres, and another of 1643 acres. How much ground does he own altogether?

3. A wholesale grain firm had at the beginning of the day 243,987 bushels of wheat. During the day's trading 21,765 bushels were sold. How much did they then have?

4. A commission house had on hand 1000 cases of canned corn. From three different canning factories they bought respectively 1276, 91, and 817 cases. How many did they then have?

5. If one telephone company uses 1,918,564 cross bars during the year, and another company in the same period uses 617,453 cross bars, how many more does the one use than the other?

The numerals isolated in lines included a list of thirty-four numerals. Twenty-eight of the list of thirty-four consisted of ordinary numerals which were selected by taking four numerals from each of the seven-numeral lengths of one to seven digits. In addition, the list included the six special form numerals, namely, 1000, 333, 25,000, 0, 99, and 637,637. They were presented to the readers on two different cards. The line space between any two numerals was 16 mm., and the lines were placed two spaces apart. These two details of arrangement were followed in order that the reading of any numeral might be entirely separate from the reading of any other. The numerals are reproduced as Selection 2 and in the same form in which they were presented to the readers.

SELECTION 2

ISOLATED NUMERALS READ BEFORE PHOTOGRAPHIC APPARATUS

(Card One)

36	3	5489	756,352	46	4,325,986
5,974	239	1	16,789	1024	354,908
2	2,374,957	1000	333	25,000	

(Card Two)

84	9317	17	2	5,236,795	256
819	1928	365	8	93,548	3,984,673
308	52	0	99	637,637	

The selection of ordinary expository prose was taken from Judd's *Psychology of High-School Subjects.* The subjects read directly from the book. Data were tabulated from the reading of ten lines by each subject. Because of defects in the records of subjects W and G only five and seven lines respectively were tabulated from their readings. The regularity in number and duration of pauses found in the data for the few lines, which were tabulated for these subjects, however, give evidence that the data for these few lines represent the normal reading of these subjects in these materials. The record which represented the reading of Hb was totally unsatisfactory for use. The ten lines of the text were each 93 mm. in length and included 101 words and 452 letters. They are reproduced as Selection 3.

SELECTION 3

Ordinary Prose Read before Photographic Apparatus

"Anyone who has struggled with the German language has an appreciation of the satisfaction which the novice feels in watching the way an expert in this language manages a separable verb. The moment the verb is used in a sentence, there arises a feeling of craving for the remainder of the verb. The skillful German places between the verb and the prefix a long series of phrases and words, but ultimately arrives with perfect precision at the end of the sentence, and gives the satisfaction which comes from a proper closing of the feeling which was started when the...."[1]

3. INSTRUCTIONS TO SUBJECTS AND DESCRIPTION OF SUBJECTS

The instructions given the readers were varied for each of the three kinds of materials which were read. When the problems were being read the subjects were asked to attack them with the normal problem-solving attitude. Each individual was provided with a pencil which he was told he might, or might not, use in computation, as he chose. The instructions which the readers received for the isolated numerals were to read the numerals successively in the lines, to read all of them accurately, and to proceed at the normal rate of speed. Each numeral was to be articulated in an easy, natural manner and in a voice which was barely audible to the observer, who stood at a distance of approximately three feet. Provision for this slight articulation was included as a means of encouraging the complete reading of all numerals. For the expository prose selection the instructions were to read silently for a clear understanding of the paragraph and at normal speed. The volume from which the selection was taken was familiar in a general way to all of the readers. They were given its title in advance and the subject-matter of the passage to be read was described as relating to the psychology of language.

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[1] C. H. Judd, *Psychology of High-School Subjects.* Boston: Ginn & Co., 1915. Pp. 190.

The six subjects, records of whose readings appear in this part of the investigation, were all male graduate students in the School of Education of the University of Chicago. Three of them had served in various preliminary studies. Subject G had read the problems of the first and second preliminary studies and was classified as a pronounced partial first reader of numerals in problems. Subjects H and Hb had served in the first and second studies respectively and were both found to be pronounced whole first readers. The original plan of the investigation specified that the subjects whose types of reading had been studied in the preliminary sections should act as subjects for the eye-movement experiments. Of the photographic records which were made of the subjects of previous studies, however, only those of G, H, and Hb were entirely satisfactory. None of the subjects reported past experiences which seemed likely to have had important influence upon his reading of the materials of this study.

4. PROCEDURE ON THE PART OF THE OBSERVER

The instructions were given to the subjects before they took their seats at the camera, and samples of each of the three kinds of materials, which were to be read, were examined by them. When the readers were properly seated before the camera they were given a brief training with practice problems and with practice sets of isolated numerals until procedure according to the instructions was mastered. After the solving of each problem, several of the subjects were asked to make brief introspective observations concerning whole and partial first reading of numerals, the re-reading of numerals and the steps used in computation. Their reports were recorded and later served as a basis for interpretation of the corresponding eye-movement records.

5. GUIDE FOR READING THE PLATES

The photographic films, upon which the lines of dots representing pauses of the eyes were recorded, were used as slides in a projection lantern. The records of the photographs were in this manner projected upon a screen, which, at the same time, held the texts of the various reading materials. The photographic picture of the subject's reading was thus superimposed upon the exact text of the materials which he had read. It was, therefore, possible to locate directly upon the lines of the text itself the letter or digit about which the attention of the subject was centered at any pause of the eye. By counting the number of dots in the lines of dots, which represented the pauses, the exact durations of the pauses were ascertained.

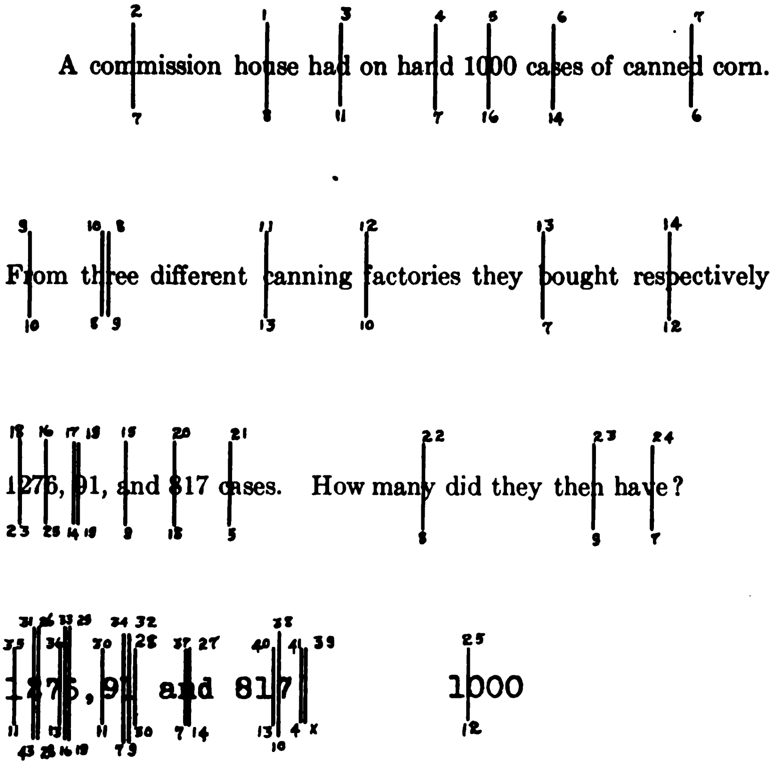
The plates, which describe readings of the problems, are numbered I–XV as presented in this chapter. The remaining plates, which describe readings of the isolated numerals, are numbered XVI–XXV and are found in chapter ix. The lines of reading materials which are found in the plates are reproductions of the lines which were read by the subjects. The short straight vertical lines which cross the lines of print represent pauses of the eye. The particular letter, digit or space which is crossed by a vertical line represents the approximate center of the field of perception which was included in that pause. The arabic numbers, 1, 2, 3, etc., above each of the vertical lines indicate the serial order of each pause among the pauses which were used in reading the problem. When the serial number of a pause moves to the left of the serial number of the previous pause a backward or regressive movement of the eye is indicated. The number at the lower end of a pause line gives the duration of the pause in units of 1/50 of a second.

The vertical lines which mark the pauses used in the first reading of the problem are located on the lines of the reproduced text. All pauses used in re-reading or in copying numerals or in computation are recorded below the last line of the problem. For convenience in interpretation the numerals which were read during such pauses are typewritten below the last line of the problem and directly below the several digit spaces occupied by these numerals in the lines below. A straight horizontal line below the vertical lines that indicate the computation pauses, describes the location of numerals which have been copied, or of answers which have been recorded.

The reading of the plates may be illustrated by the reading of Plate XII, which is as follows: Pause 1, which falls in the first line of the problem, begins the first reading of the problem. It is located on the letter "a" of the word "wholesale" and the duration of the pause is 10/50 of a second. Pause 2, which is a backward or regressive movement from Pause 1, is located on the letter "o" of "wholesale" and the duration of this pause is also 10/50 of a second. There are seven pauses in line 1. Pause 9, which is in line 2, falls on digit "9" of the numeral "243,987" and its duration is 20/50 of a second. It is a regressive movement from Pause 8. Pause 22 completes the first reading of the problem.

The pauses which follow represent the process of computation and are recorded below the text of the problem. Pause 23, which is the first pause used in the process of computation, is apparently a locating pause. It is followed by Pause 24, by which digit "7" of the numeral

PLATE I

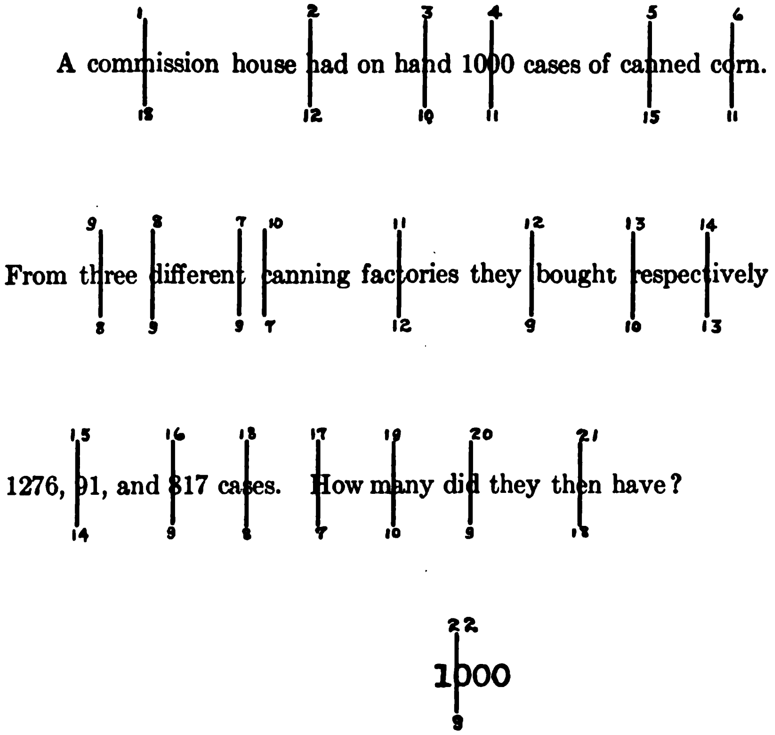

A commission house had on hand 1000 cases of canned corn.
From three different canning factories they bought respectively
1276, 91, and 817 cases. How many did they then have?
1276, 91 and 817
1000

First reading of Problem 4 by Subject B and his procedure in solving the problem. *x* indicates that it was impossible to determine with precision the duration of the pause.

"243,987" is read in 41/50 of a second. Attention then passes immediately with Pause 25 to digit "5" of "21,765," which digit is to be subtracted from the afore-mentioned digit "7." Pauses 26, 27, etc., continue the process of computation, which ends with Pause 32. The subject then shut his eyes and the record was finished.

Plate I records the reading of Problem 4 by Subject B. In the first reading of the problem, which is represented by the pauses in the lines of the text itself, an initial regression is noted in line 1. Pause 1 evidently was not located closely enough to the left end of the line for a satisfactory beginning. Similar initial regressive movements appear in lines 2 and 3. During pauses 16 to 19, inclusive, the two numerals 1276 and 91 were given whole first readings. With Pause 24 the first reading of the problem was finished.

PLATE II

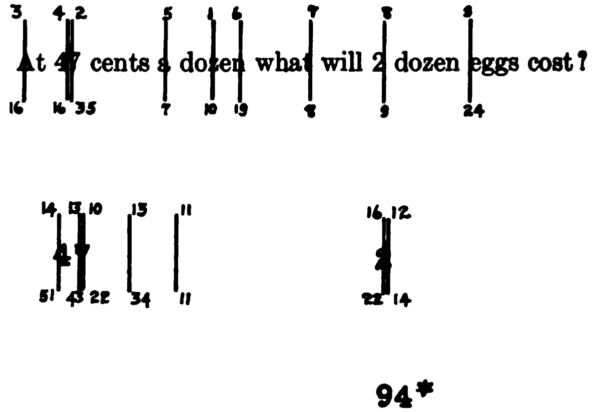

A commission house had on hand 1000 cases of canned corn.
From three different canning factories they bought respectively
1276, 91, and 817 cases. How many did they then have?
1000

First reading of Problem 4 by Subject G and re-reading the numeral 1000

The remaining pauses, which represent subsequent procedure with the problem, are placed below the lines of the text. The numeral 1000 was re-read with Pause 25. The records do not give sufficiently detailed information for the identification of the purposes of the individual pauses subsequent to Pause 25. The computation was, however, conducted directly from the problem card and apparently the subject added the numerals 1276 and 91 first, and then added 817 to that result. The answer was recorded during, or immediately after, Pause 41.

Plate II contains the record of Subject G for Problem 4. He proceeded rapidly with the first line, but read the second line with a number of pauses which is relatively large as compared with the number of pauses on his other lines. The numeral 1000 was read in detail with Pause 4 in a time interval of 11/50 of a second. With pauses 15 and 16 he gave partial first readings to the three numerals, 1276, 91, and 817. Such partial first readings of these numerals were in this instance sufficient preparation for computation with them. The first reading of the problem was completed with Pause 21.

PLATE III



*The answer, 94, was recorded during Pause 16 at the point indicated.

First reading of Problem 1 by Subject W and multiplication direct from the problem card with one numeral used as the "base of operations."

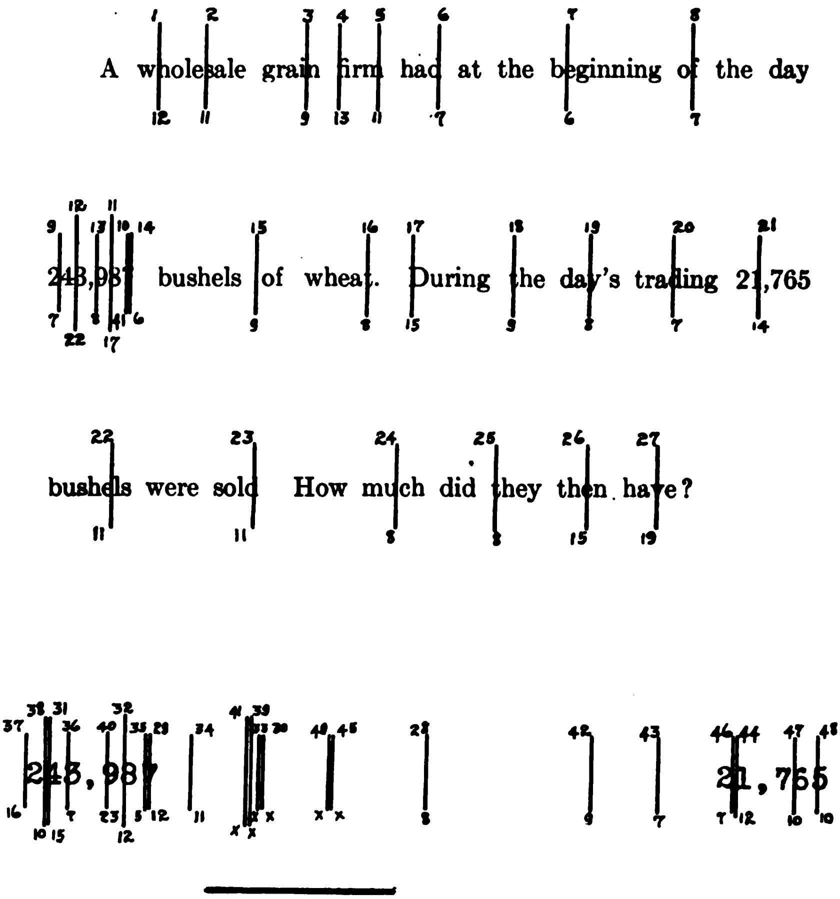
Immediately after the first reading, the subject quickly re-read 1000. After Pause 22, the record was unsatisfactory.

Plate III shows the first reading of Problem 1, the re-reading of both of the numerals, and the process which was followed in solving the problem. The first pause fell much too far to the right of the beginning of the line and two regressive movements were necessary as shown by pauses 2 and 3. The numeral 47 was evidently carefully read in the two pauses of 16/50 and 35/50 of a second which it received. The first reading of the problem was completed with Pause 9.

The re-reading began immediately with Pause 10 on the numeral 47. It was a long pause of greater than average duration notwithstanding the fact that 47 had been carefully read during the first reading.

Pause 11 probably served as a guiding pause in the long move from 47 to 2. This last numeral was re-read during Pause 12. After this the subject returned to the numeral 47 and made it the base of the operation

PLATE IV


A wholesale grain firm had at the beginning of the day
248,987 bushels of wheat. During the day's trading 21,765
bushels were sold How much did they then have?
248,987
21,765

The numerals were copied at the place indicated by the horizontal line.

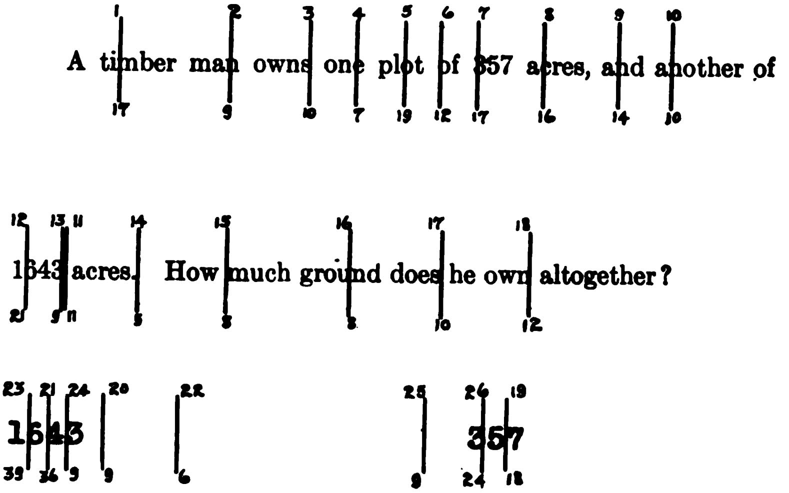
First reading of Problem 3 by Subject Hb and re-reading the numerals for copying. *x* indicates that it was impossible to determine with precision the duration of the pauses.

of multiplication, which took place during pauses 13 and 14. When the computation was completed, the eye returned to the vicinity of the numeral 2, where the answer was recorded during Pause 16.

Plate IV illustrates the first reading of Problem 3 and the re-reading of both of its numerals for copying by Subject Hb. The numeral 243,987 was given a detailed whole first reading, while the numeral 21,765 in the same line was passed by with a rapid partial first reading. Of the large number of pauses used in reading line 2, six were placed on the digits of one numeral. The first reading was concluded with a relatively rapid reading of the last line.

Immediately after the first reading, pauses 28 and 29 were used apparently in locating the first numeral and Pause 30 in locating the place where it was to be copied. During pauses 31 and 32, the numeral was re-read. During pauses 33 and 34 reference was again made to the place of copying, while during pauses 35 and 36 the numeral was located again. With pauses 37 and 38 apparently the first group of digits was re-read, and the second group of digits was re-read with Pause 40. The second numeral appears to have been located with pauses 42 and 43, and it was then re-read. During Pause 45 or Pause 49 (or during both pauses) 21,765 was copied. After Pause 49, the record could not be followed accurately.

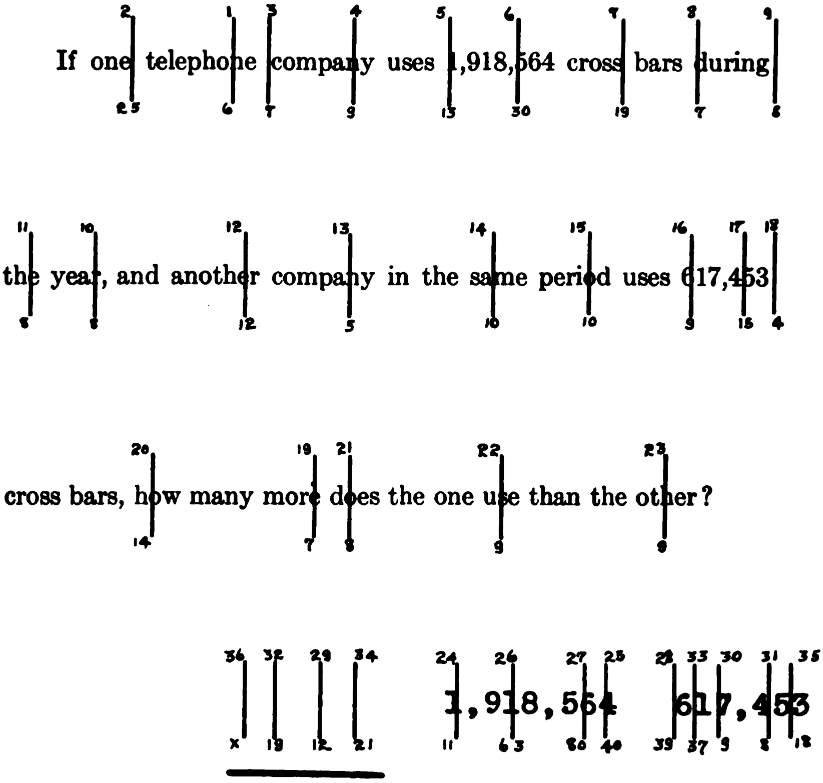
PLATE V


A timber man owns one plot of 357 acres, and another of
1643 acres. How much ground does he own altogether?
1643
357

First reading of Problem 2 by Subject Hb, re-reading the first numeral and subsequent re-reading both numerals for copying.

Plate V shows that Subject Hb gave a very detailed and cautious first reading to Problem 2. Ten pauses, none of which represented a regressive movement, were required to read the first line. In the second line, the numeral 1643 was given a whole first reading with pauses 11, 12, and 13.

PLATE VI


If one telephone company uses 1,918,564 cross bars during
the year, and another company in the same period uses 617,453
cross bars, how many more does the one use than the other?
1,918,564
617,453

The numerals were copied at the place indicated by the horizontal line.

First reading of Problem 5 by Subject M and re-reading and copying the two numerals. *x* indicates that it was impossible to determine with precision the duration of the pause.

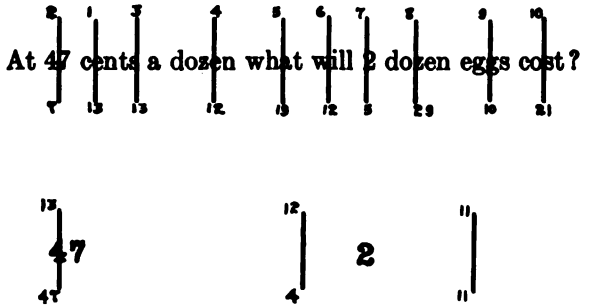
When the first reading was finished Hb proceeded immediately to re-read 357, apparently moved by some such purpose as the re-location of the numeral or the verification of one of its digits. He then re-read and copied 1643 with pauses 20 to 24, inclusive, whereupon he passed to 357, which he re-read with Pause 26. After this pause, the subject's attention was directed to the margin at the left of the text of the problem.

During the first reading of the first two lines of Problem 5, as shown in Plate VI, Subject M used a large number of pauses of relatively short durations. The last line of the problem was read with much greater rapidity. Each of the long numerals was given a partial first reading. M approached the second numeral with a short pause and left it with another short pause. This method of reading long numerals was followed by him in the case of isolated numerals in several instances to which attention is called in the comment on plates XX–XXI.

Immediately at the end of the first reading he re-read the numeral 1,918,564 with pauses 24 to 27, inclusive, and copied it at the same time at the point indicated without moving his eyes from the numeral. The second numeral was re-located with Pause 28, and the first numeral which had now been copied was located with Pause 29 in order to determine where to copy the second numeral. This numeral was then re-read and copied at the place indicated in the plate.

Plate VII shows Subject Hb reading the first problem very cautiously. With only two exceptions every word and numeral in the problem was

PLATE VII



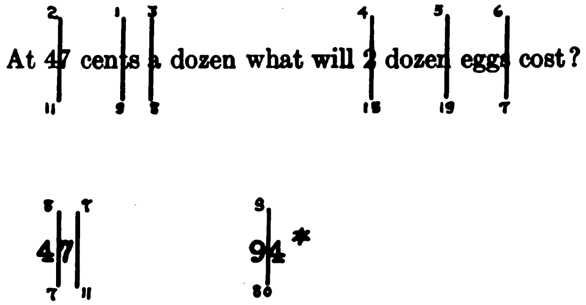
First reading of Problem 1 by Subject Hb and re-reading the first numeral for copying.

read individually. Such a large number of pauses is in sharp contrast with the relatively small number of pauses which were used by B and G in reading the same problem as shown in plates VIII and X.

After the first reading, which was finished with Pause 10, the numeral 2 was not re-read. The first numeral, however, was re-read with Pause 13 and immediately copied on the problem card in the margin to the left of the text.

In Plate VIII a rapid first reading of the text of the problem by Subject B is observed. Immediately at the conclusion of the first reading, the subject proceeded to the first numeral which was used as the "base of operations" for the multiplication process in pauses 7 and 8. The numeral 2 meanwhile was retained in memory. The answer was recorded during Pause 9 immediately below the word "what" in the text of the problem.

PLATE VIII



* The answer, 94, was recorded at the point indicated during Pause 9.

First reading of Problem 1 by Subject B and the process of computation with the first numeral as the "base of operations."

In Plate IX Subject G is shown reading Problem 2 with a relatively small number of pauses. Only four pauses were used in the last line. The first numeral was read partially while the second numeral, 1643, was read in detail. G is the only subject who, when the isolated numerals were being read, was able to read four digits in detail with one pause. The instances in which he did this are described in the comment concerning plates XVI and XVII.

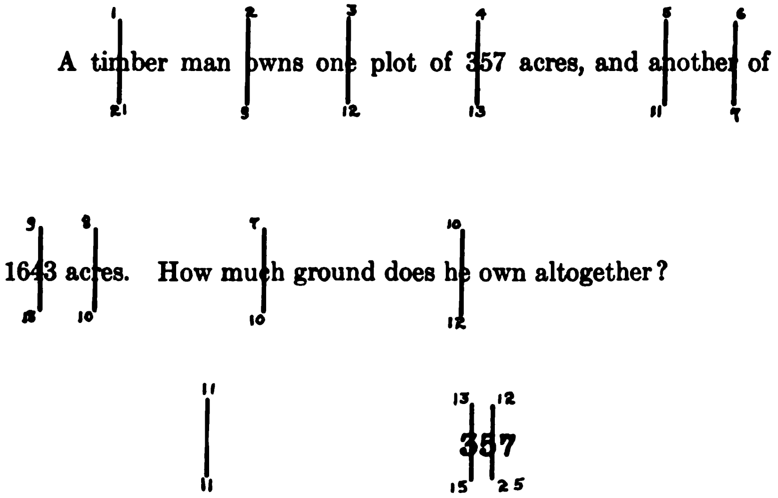
When the first reading was completed, the subject turned his attention to the numeral 357 and used it as the "base of operations" during the process of addition. This operation was carried on "mentally" and directly from the problem card. One or two digits were taken at a time, the computation starting from the right with Pause 12. The answer was recorded during Pause 13 or immediately thereafter. At the end of Pause 13 the subject closed his eyes.

The plate itself supplies ample internal evidence of the fact that the numeral 1643 was wholly read with the first pause which was 18/50 of a second in duration. Such is undoubtedly the case since the subject was able to produce the correct answer without ever looking at the numeral again.

The reading and solving of Problem 1 by Subject G is described in Plate X. The conditions of the problem and the identity of the numerals were evidently grasped during the first five or six pauses. The numerals were not re-read and the answer was recorded during either Pause 8 or Pause 9, or during both.

During pauses 6 and 8 the subject may have been occupied with "mental" computation. This suggestion is offered as a possible explanation of the fact that Pause 6 was not located on any reading material, but was nevertheless the longest of all pauses used in connection with the problem. It does not seem probable that Pause 7 was needed by this subject as a re-reading pause in this problem. If computation was proceeding during pauses 6 and 7, evidently the eyes were roving around without direction. Such undirected roving occurred very rarely, if at all. In most cases, the eyes of the subjects were fixed on the numerals which were involved in the computation.

PLATE IX

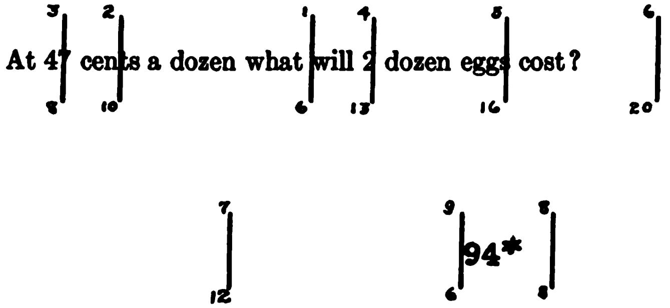

1 2 3 4 5 6
A timber man owns one plot of 357 acres, and another of
21 9 12 13 11 7
9 8 7 10
1643 acres. How much ground does he own altogether?
18 10 10 12
11
11
13 12
357
15 25

First reading of Problem 2 by Subject G and the process of adding the two numerals.

The first reading, the re-reading, and the solution of Problem 1 by Subject M are shown in Plate XI. Apparently the subject became confused on the first few words of the line as is indicated by the backward and forward movements of the pauses. Such confusion in the reading of problems was found in but very few instances.

After the first reading, some of the last words of the problem and the numeral 2 were re-read. Such re-reading of words in a problem was a very rare occurrence on the part of the subjects of this investigation. The answer was recorded immediately after Pause 18 in the margin of the card to the left of the text of the problem.

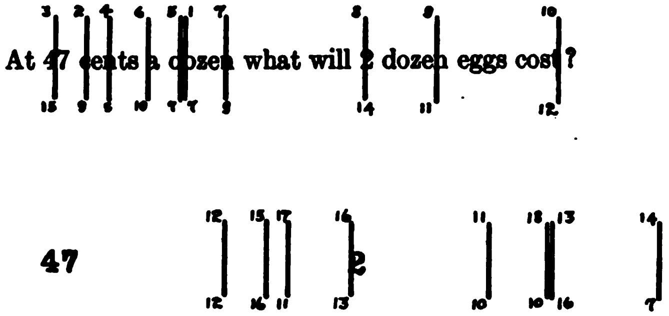
PLATE X



* The answer, 94, was recorded during Pause 8 or 9.

First reading of Problem 1 by Subject G and the process of computation

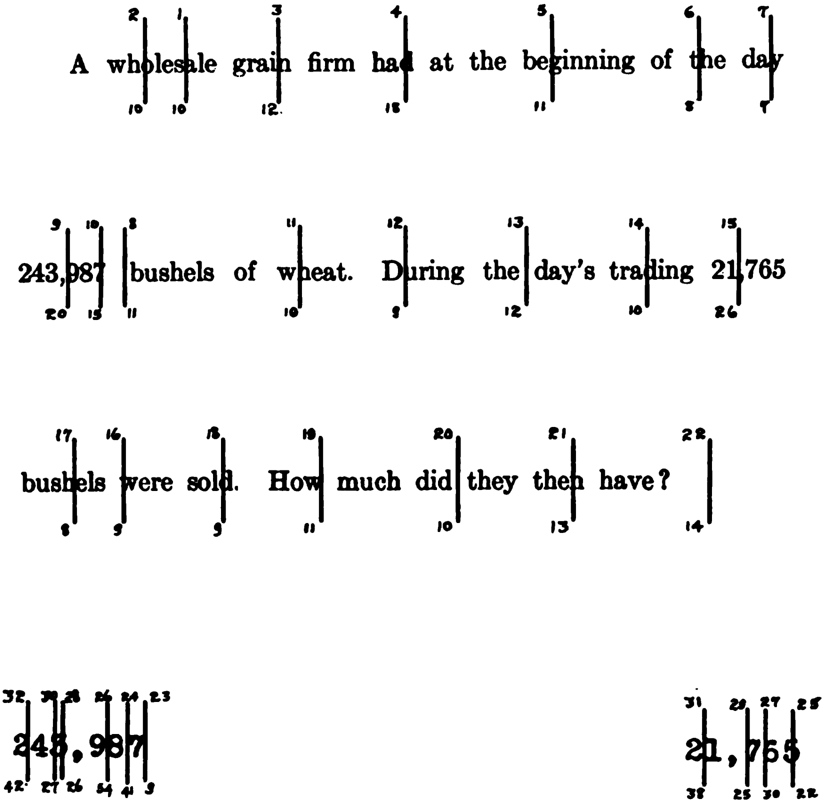
PLATE XI



First reading of Problem 1 by Subject M, re-reading words and the process of computation.

During the first reading of Problem 3, as shown in Plate XII, Subject G gave both of the numerals partial first readings. Immediately at the end of the first reading, which was finished with Pause 22, he began the process of subtracting the second numeral from the first. With Pause 23 he located the first numeral and with Pause 24 perceived its first right-hand digit. He then quickly glanced at the first right-hand digit of the second numeral with Pause 25. The movements back and forth between the two numerals continue steadily, one-digit place being computed at each movement, until the answer was recorded immediately after Pause 32.

PLATE XII

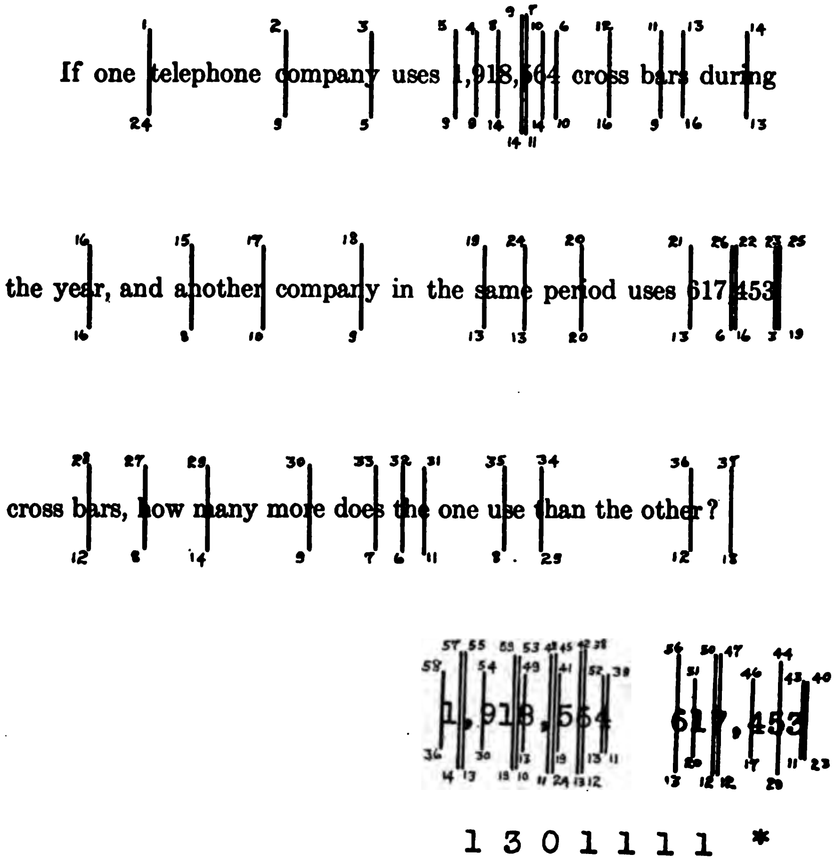

A wholesale grain firm had at the beginning of the day
243,987 bushels of wheat. During the day's trading 21,765
bushels were sold. How much did they then have?
243,987
21,765

First reading of Problem 3 by Subject G and the process of computation

Attention should be called to the fact that since all of the digits of the answer were the digit 2, it was easier for the subject to hold the answer in memory as long as he did before recording. The larger numeral is seen to have given one more pause, not counting Pause 23, and the average duration of its pauses was greater than that of the smaller numeral. The computation began and ended with the digits of the longer numeral.

In Plate XIII are found illustrations of pronounced whole first reading of numerals by Subject H. Even the text of the problem seems to have been read and re-read with very short spans of attention and with meticulous care.

PLATE XIII


If one telephone company uses 1,918,564 cross bars during
the year, and another company in the same period uses 617,453
cross bars, how many more does the one use than the other?
1,918,564
617,453
1 3 0 1 1 1 1 *

* The answer, 1301111, was recorded at the point indicated.

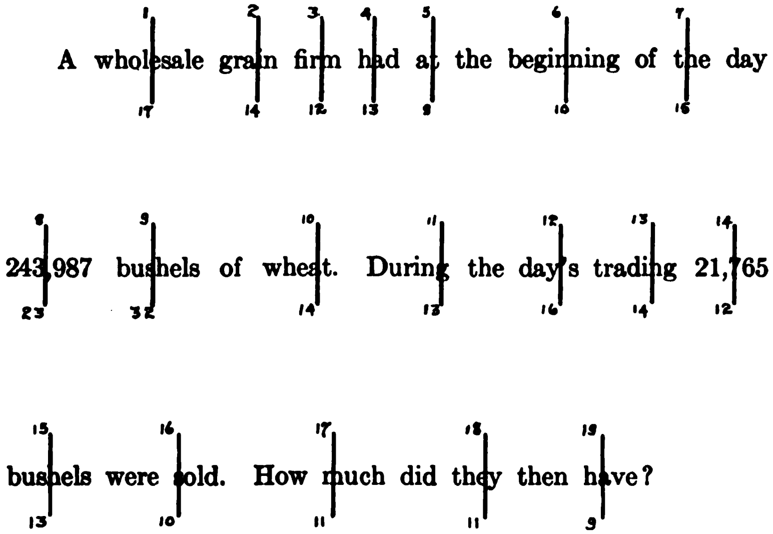
First reading of Problem 5 by Subject H and the process of computation

After the first reading, which is concluded with Pause 37, the computation began immediately and proceeded in a manner similar to that described in the comment concerning Plate XII. The numeral 1,918,564 was used as the "base of operations"; the computation both began and ended with its digits.

The figures of the answer, 1,301,111, were recorded one digit at a time, as they were produced by the computation, and immediately below the words, "use than the other," in the text of the problem. Several of the pauses were used in directing the hand as it recorded the digits of the answer. This was true of pauses on each of the two numerals. An effort is made to give the numbers of such pauses in Table XXVI.

In Plate XIV two excellent cases of pronounced partial first readings are found. Although the numerals are five and six digits in length, respectively, nevertheless, each one was read with a single pause. In this plate a clear illustration of rapid reading of the last line of a problem is also found. Only five pauses were required for reading line 3 and their durations were less than this subject's average pause-duration on words as given in Table XVIII.

PLATE XIV


1 2 3 4 5 6 7
A wholesale grain firm had at the beginning of the day
17 14 12 13 8 10 15
8 9 10 11 12 13 14
243,987 bushels of wheat. During the day's trading 21,765
23 32 14 13 16 14 12
15 16 17 18 19
bushels were sold. How much did they then have?
13 10 11 11 9

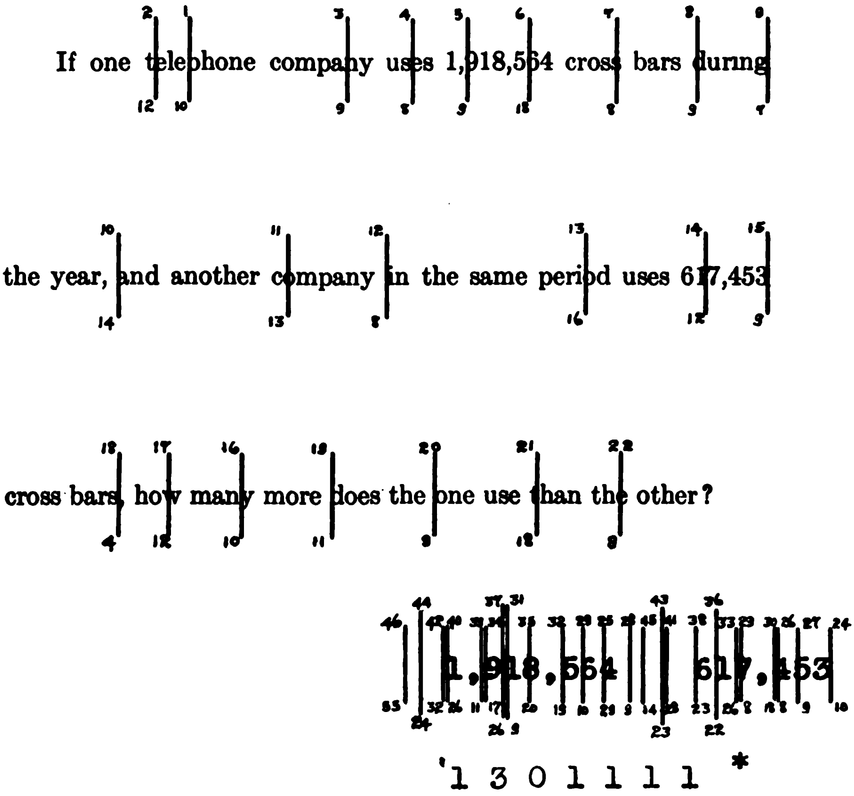
First reading of Problem 3 by Subject W with partial reading of numerals

Plate XV exhibits the process of solving Problem 5 as it was carried on by Subject G. His procedure was similar to that of Subject H which is described in the comment accompanying Plate XIII.

The use to which Subject G put each individual pause in the computation is described in Table XXVI. An important difference should be noted between the procedures of subjects G and H in solving Problem 5.

Subject G, as is shown by the location of pauses 23 and 24 of Plate XV, began the computation by taking the first right-hand digit of 617,453 and proceeded to relate it to the corresponding digit of 1,918,564. He continued the process by moving from right to left. Subject H, on the other hand, began the computation by taking the first right-hand digit of 1,918,564, and proceeded to find the corresponding digit of 617,453. He continued the process, as did Subject G, by moving from right to left. Both subjects, however, appear to have emphasized the larger numeral as the "base of operations." The details are given in Table XXVI.

PLATE XV


If one telephone company uses 1,918,564 cross bars during
the year, and another company in the same period uses 617,453
cross bars, how many more does the one use than the other?
1,918,564
617,453
1 3 0 1 1 1 1 *

*The answer, 1301111, was recorded at the point indicated.

First reading of Problem 5 by Subject G and the process of computation

This concludes the general description of the photographic records. In the following divisions of the report various phases of the reading of numerals will be discussed in greater detail. In the next chapter a description is given of the first reading of the problems material. Chapter viii provides a discussion of the re-reading of problems and the processes of computation. The reading of isolated numerals is described in chapter ix. In the last chapter the performance of the subjects of this investigation is compared with that of the subjects of an important investigation by another author, and finally the report concludes with a discussion of the differences in the demands which are made upon the attention of readers by the three different types of reading-materials.

CHAPTER VII

FIRST READING OF NUMERALS IN PROBLEMS

1. INTRODUCTION

When examining plates I–XV, which reproduce the lines of the problems as they were read and which locate within the lines the pauses as they occurred in the readings, the unusually large number of pauses per line stands out very conspicuously. The average number of pauses per line for all subjects is 8.08; and there are individual lines in which as many as 10, 11, 12, 13, and even 14 pauses are found. The large number of pauses appears all the more remarkable when it is remembered that all of the readers were advanced graduate students, who are entirely familiar with simple arithmetical problems, and who would be expected to qualify as better than average readers.

Attention should be called at this point to the fact, which is given more detailed treatment in a later section, that the subjects of this study were not slow readers. It appears that there is good ground for assuming that the reading of arithmetical problems is more difficult than the reading of ordinary prose. The question suggests itself, therefore: Did the two elements of which the problems are composed, namely, the numerals and the accompanying words, make equal demands upon the attention of the individuals who read them in this study? The data, by means of which comparisons may be drawn between the numerals and the words, with respect to average duration of pauses, average number of letters or digits included per pause, and the percentage which the regressions are of the total number of pauses, are presented in tables XVII–XIX.

2. COMPARISON BETWEEN THE READING OF NUMERALS AND WORDS IN PROBLEMS

It is evident from a glance at Table XVII that there is a very great difference in the average ranges of acts of perception according as digits in numerals or letters in words are read. In the readings of all of the subjects the average number of digits included by a pause on numerals was less than the average number of letters included by a pause on words. The disparity between these averages is slightly greater in the cases of the three whole first readers B, H, and Hb, all of whom show shorter ranges of perception of digits than the three other subjects, who are partial first readers. Even the partial first readers, however, in every case, perceived on the average less than half as many digits as letters per pause.

The explanation of this shorter range of perception for numerals than for words, when both occur in the same arithmetical problem is probably the same as that given by Dearborn in accounting for the short "number span of attention," which he had noted.[1] The digits in numerals do not appear constantly in the same combinations as do the letters in words. In consequence, the numerals in their continually new combinations of digits make larger demands upon the attention of readers. Every individual digit is significant in itself and must be noted; and all of the digits must be viewed in combination before the numeral is completely read. Words, however, as several investigations of the span of perception have shown, are perceived as wholes. The letters appear and reappear in the same regular combinations, which become familiar in the earlier years of schooling. Readers have become accustomed to them as words and are able to proceed easily with whole words as units of perception.

TABLE XVII

AVERAGE NUMBER OF DIGITS INCLUDED IN A PAUSE ON NUMERALS CONTRASTED WITH AVERAGE NUMBER OF LETTERS INCLUDED IN A PAUSE ON WORDS DURING FIRST READING

	SUBJECTS						AVERAGE FOR ALL SUBJECTS
	G	M	W	B	H	Hb	
Average number of digits included in a pause on numerals	3.40	2.35	2.93	1.81	1.88	1.88	2.38
Average number of letters included in a pause on words	7.30	5.95	6.79	7.90	5.18	5.74	6.47

NOTE.—Each subject read the five problems which included 12 numerals totaling 47 digits, and 111 words totaling 482 letters.

As noted in the foregoing paragraph, the pauses on numerals are more concerned with analysis and combination of the component digits than the pauses on words are with similar processes with the letters. Such a difference would be expected to make itself evident in a greater average duration for the pauses on numerals than for the pauses on words. The data which are displayed in Table XVIII justify such an expectation. With each of the several subjects, it is seen that the average duration of the pauses on numerals was decidedly greater than the average duration of the pauses on words. The average for all subjects of the average pause-durations, when numerals were read, is approximately 40 per cent greater than the same average duration when words were being read.

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[1] W. F. Dearborn, "The Psychology of Reading, An Experimental Study of the Reading Pauses and Movements of the Eye," *Columbia University Contributions to Philosophy and Psychology*, Vol. XIV, No. 1 (1906), pp. 70–71. New York: The Science Press.

TABLE XVIII

AVERAGE DURATION OF PAUSES IN FIFTIETHS OF A SECOND ON NUMERALS CONTRASTED WITH AVERAGE DURATION OF PAUSES ON WORDS DURING FIRST READING

	Subjects						Average for All Subjects
	G	M	W	B	H	Hb	
Total number of pauses used by subject in reading: Numerals..	14	20	16	26	27	25	....
Total number of pauses used by subject in reading: Words....	66	81	71	61	93	84	....
1. Average duration of pauses on numerals	13.92	15.20	15.31	18.46	13.30	13.48	14.98
Average variation	3.92	4.54	5.35	5.92	3.97	5.0	4.77
2. Average duration of pauses on words	10.72	9.87	13.02	9.18	11.74	10.99	10.92
Average variation	2.27	1.41	3.38	1.16	4.13	2.94	2.55

A comparison between the numerals and the words in respect to the percentage which the number of regressive pauses is of the total number of pauses for a subject, yields further evidence of the greater reading-demands made by numerals. In the cases of subjects M, B, H, and Hb, as found in Table XIX, decidedly larger percentages of regressive pauses appear in the case of the numerals than upon the accompanying words. The explanation of such differences probably lies in the difficulty of reading in the same lines, materials which call for such different ranges of attention and durations of pauses as did the numerals and the words in these problems. When proceeding at the rate of reading and with the range of perception which is adapted to words,

TABLE XIX

PERCENTAGE OF REGRESSIVE PAUSES ON NUMERALS CONTRASTED WITH PERCENTAGE OF REGRESSIVE PAUSES ON WORDS DURING FIRST READING

	Subjects					
	G	M	W	B	H	Hb
Total number of regressive pauses located by subject on: Numerals....	2	6	1	7	10	5
Total number of regressive pauses located by subject on: Words......	11	10	4	8	22	1
Percentage which the number of regressive pauses on:						
1. Numerals is of the total number of pauses on numerals..................................	14.28	30.0	6.25	26.9	40.0	20.0
2. Words is of the total number of pauses on words	16.6	12.3	5.63	13.1	23.65	1.19

the subject apparently passes over some of the numerals with a reading which does not satisfy him, and he immediately returns to read or to re-read all or a part of the numeral.

3. PARTIAL AND WHOLE FIRST READING OF NUMERALS

Whole first reading was defined in the first preliminary study of the investigation to include such readings of numerals during the first reading of a problem as noted the character of the numeral and the identity and place in the numeral of each individual digit. Any reading of a numeral which did not include these items was called a partial first reading. In Table XX the kind of reading given each of the twelve numerals in the problems by each of the several subjects is described in detail. The data which are included in this table are based upon introspective observations concerning their readings by several of the subjects, and upon inferences which were drawn directly from the plates. With the longer numerals a very small number of pauses of short duration in some instances gave indisputable evidence of partial reading. In several of the records answers to problems which included shorter numerals were computed and recorded when the numerals had been read only on the first reading; obviously such readings were whole first readings. A few readings could not be placed with certainty in either category and are, therefore, marked D, which means doubtful. Plates II, IV, VI, XII, and XIV present instances in which numerals received partial first readings, and plates I, IV, IX, and XIII show other instances in which numerals received whole readings.

There are marked differences between partial and whole first readings of the longer numerals in respect to the number of pauses per numeral and the total time required for reading the numeral. These differences are quickly apparent when Table XX and the plates which bear illustrations of the two methods are studied in detail. Illustrations of both methods of reading are found in Plate IV which represents the reading of Problem 3 by Subject Hb. In this problem one of the numerals, 243,987, was given a whole first reading which included six pauses and measured a total reading-time of 101/50 seconds, while the other numeral, 21,765, was given a partial reading which included only one pause with the duration of 14/50 of a second.

Further emphasis is given to the difference between partial and whole reading of numerals by a comparison of the first readings of the numerals in the problems with the readings of the numerals isolated in lines. As prescribed by the conditions, the readings of the isolated numerals

TABLE XX

DURATION IN FIFTIETHS OF A SECOND, AND SERIAL ORDER OF THE SEVERAL PAUSES USED IN WHOLE AND PARTIAL FIRST READINGS OF NUMERALS

SUBJECTS	Problem Number...	1		2		3		5		4				ALL PROBLEMS		
														Number of Subjects		
	Numerals which were read in problems..	2	47	357	1643	21,765	243,987	617,453	1,918,564	1000	1276	91	817	Partial Read-ings	Whole Read-ings	Doubt-ful Cases
G	Durations of pauses in serial order.....	13 (W)	8 (W)	13 (P)	18 (W)	26 (P)	20, 15 (P)	12, 9 (P)	9, 18 (P)	11 (W)	..... (P)	14 (D)	9 (P)	7	4	1
M	Durations of pauses in serial order.....	14 (W)	15 (W)	12, 21, 19 (W)	22, 23 (W)	10, 20, 8 (D)	9, 17 (P)	9, 15, 4 (P)	13, 30 (P)	14 (W)	14 (P)	..... (P)	16 (P)	6	5	1
W	Durations of pauses in serial order.....	9 (W)	16, 35 (W)	9 (P)	19 (P)	12 (P)	23 (P)	9, 9 (P)	15, 13, 24 (P)	13 (W)	14 (P)	7 (P)	18 (P)	9	3	....
B	Durations of pauses in serial order.....	15 (W)	11 (W)	18 (D)	19 (P)	25, 18 (D)	8, 45, 9, 18, 14 (W)	12, 34, 14, 14 (W)	8, 9, 20, 18, 36 (W)	16 (W)	25, 23 (W)	14, 19 (W)	18 (D)	1	8	3
H	Durations of pauses in serial order.....	14 (W)	19 (W)	7, 33 (W)	11, 14, 14 (W)	11, 10 (P)	12, 17, 7 (P)	13, 16, 3, 19, 16 (W)	9, 9, 10, 11, 14, 14, 14 (W)	15 (W)	..... (P)	17 (D)	20 (P)	4	7	1
Hb	Durations of pauses in serial order.....	5 (W)	7 (D)	17 (D)	11, 21, 9 (W)	14 (P)	7, 41, 17, 22, 8, 14 (W)	11, 23 (P)	10, 9, 13, 11 (D)	12 (W)	13, 38 (W)	12 (W)	20, 15 (W)	2	7	3
ALL SUBJECTS	Number of:															
	Partial readings...	.....	.....	2	2	4	4	4	3	.....	4	2	4			
	Whole readings....	6	5	2	4	....	2	2	2	6	2	2	1			
	Doubtful cases....	.....	1	2	....	2	....	....	1	.....	.....	2	1			

NOTE.—The capital letters, W and P, in the columns above are abbreviations for whole and partial first readings, respectively The letter D is used to designate doubtful cases which the records do not clearly place in either of the other classifications.

were of the quality of whole readings. The data are arranged in Table XXI for such a comparison between the two sets of numerals in each of the several digit-lengths with respect to the average number of pauses per numeral, the average pause-duration, and the average time required for reading individual numerals. In respect to each of the three points named for comparison the isolated numerals are found to have larger averages than the problem numerals in each of the several digit-lengths. If only those problem numerals which were given partial first readings were included in the comparison, the differences between the two sets of numerals would be appreciably greater than they are.

On the other hand a certain degree of qualification is attached necessarily to the significance of the large differences found because of the effect probably produced on the reading of the isolated numerals by one of the conditions under which they were read. The slight articulation used in reading the isolated numerals presumably acted to diminish the speed with which they were read. It should be noted also that all of the subjects gave evidence of greater interest in reading and solving the problems than in reading the numerals isolated in lines. The probable effect of such great interest in the problems was to stimulate the readers to a more rapid rate of reading the numerals in problems than the numerals of corresponding digit-length which were isolated in lines.

Proper allowances should be made for the differences which were produced in the readings of the two sets of numerals by such variations in conditions as are named above. When this allowance is made, it is found that the whole first readings which were given the longer numerals in the problems by the whole first readers include numbers of pauses and total reading-times per numeral which are similar to those found in the readings of the isolated numerals. The whole first reading of numerals in problems is evidently similar in kind to the reading of numerals isolated in lines.

As was found in the first preliminary study, marked differences appear between the shorter and longer numerals in respect to the number of times in which they were partially and wholly read during first readings. The one- and two-digit numerals were read in detail in most instances in the present study as they were in previous studies. Only one pause, for the most part, was required for the reading of the shorter numerals and the durations of such pauses ran as low as 5/50 and 8/50 of a second. The longer numerals on the other hand received a slightly greater number of partial readings than whole readings. The partial

TABLE XXI

First Reading of Numerals in Problems Contrasted with the Reading of Isolated Numerals of Corresponding Lengths

(Time unit = 1/50 of a second)

Digit-length of numerals.....	1		2		3		4		5		6		7	
Number of numerals in problems and of numerals isolated in lines which were read by each of the six subjects......	In Problems	Isolated	In Problems	Isolated	In Problems	Isolated	In Problems	Isolated	In Problems	Isolated	In Problems	Isolated	In Problems	Isolated
	1	4	1	4	1	4	1	4	1	4	2	4	1	4
Average number of pauses per numeral..................	1.0	1.15	1.17	1.20	1.50	1.90	1.83	2.40	1.66	2.90	3.08	3.70	3.83	4.15
Average pause-duration.......	11.66	19.30	15.71	22.86	16.44	27.04	16.46	26.28	15.40	28.43	11.46	26.88	14.64	25.82
Average time required for reading individual numerals.	11.66	21.45	18.5	28.7	24.66	48.05	30.16	59.65	25.66	77.75	35.17	94.05	56.16	104.54

Note.—The numerals of Problem 4 were not included with the numerals of the other problems when the averages presented in the table were computed readings for the five-digit numerals included one pause for the most part; and in the six- and seven-digit numerals two pauses were included in most instances. In respect to proportion of partial readings received, the compact group of three numerals in Problem 4, which are placed one immediately after the other, may be classified with the longer numerals.

The familiar numeral 1000 has received a kind of reading which distinguishes it from other numerals of the same length, wherever it has appeared in the preliminary studies. In the present study 1000 was given whole first readings without exception. In no instance was more than one pause required for the reading, and the lengths of the pauses closely approximate average pause-durations. For whole first readings of other numerals of four-digit length, which are found in the problems, two or three pauses were required. Unlike the other four-digit numerals, 1000 is evidently read as a whole, as words are read.

It is probable that the form of 1000, which is that of the digit "1," followed by the very obvious group of three "0" digits is easier of perception than any ordinary group of four digits. It is probably easier of perception than any numeral which is made up of a group of four digits all of which are the same digit. The frequency of appearance of 1000 in the experience of the average reader is probably greater than that of any other single combination of four digits. By virtue, therefore, of the obviousness of its structure and by virtue of the frequency of its use the numeral 1000 has become familiar to the average reader in the same sense that words are familiar, and in consequence is read as words are read.

The number of digits which it is possible to read partially in one pause of partial reading is relatively large. The five digits of the five-digit numerals were read with one pause in three of the four instances when they were partially read. One of the six-digit numerals was read one time with one pause, as is shown in Table XX. The six and seven digits of the six- and seven-digit numerals were, however, read with two pauses in most instances when they were partially read. The usual number of digits read at one pause when such longer numerals were read partially is, therefore, either three or four.

In the preliminary study which was concerned with the range of recall from the first reading of numerals in problems it was shown that in a great preponderance of instances the subjects were able to recall at least the number of digits in a numeral. In view of this fact it seems reasonable to assume that one or more of the subjects who read the five-digit numerals partially and with a single pause, were able to read all five of the five digits at one pause, at least to the extent of noting that a numeral was there and that its length was five digits. Apparently, therefore, it is possible for subjects to read to this extent as many as five digits at one act of perception.

4. THE SEVERAL SUBJECTS AS PARTIAL AND WHOLE FIRST READERS

The largest factor in determining whether the longer numerals shall be given partial or whole first readings is found in the attitude of individual subjects toward these numerals. The same numerals were given partial readings by some of the subjects and whole readings by others. An examination of the data in Table XX makes it evident that some of the subjects gave partial readings with noticeable consistency to the longer numerals, while other subjects with approximately equal consistency gave whole readings to these numerals. Subjects G, M, and W clearly exhibit the former tendency and may, therefore, be classified as partial first readers, while B, H, and Hb illustrate the latter tendency and may be called whole first readers.

5. RELATIVE VALUE OF PARTIAL AND OF WHOLE FIRST READING

Any determination of the relative value of whole and partial reading as methods of reading numerals during the first reading of a problem will be concerned to a large extent with the question as to which of the methods is more economical of the reader's time. This question resolves itself in large part into a comparison between the partial and whole first readers in respect to the total time required to read all of the numerals of the problems. The three partial readers G, M, and W, as is readily seen by inspection of Table XXII, used decidedly shorter total times

TABLE XXII

READING OF NUMERALS IN PROBLEMS BY PARTIAL FIRST READERS CONTRASTED WITH READING OF NUMERALS IN PROBLEMS BY WHOLE FIRST READERS

(Time unit = 1/50 of a second)

	SUBJECTS					
	Partial First Readers			Whole First Readers		
	G	M	W	B	H	Hb
Total time required to read all numerals	195	304	245	480	359	337
Total number of pauses required to read all numerals	14	20	16	26	27	25
Average pause-duration	13.92	15.20	15.31	18.46	13.30	13.48

NOTE.—Each subject read all five problems which included twelve numerals.

for the first reading of all of the numerals than the whole readers B, H, and Hb. Partial first reading, therefore, in so far as time required for reading the numerals is concerned, was undoubtedly the more economical of the two methods.

The words of the problems were also read more rapidly by the partial first readers, although the case is not as clear for the words as it is for the numerals. The details are given in Table XXIII. The fastest reader of the words is the whole first reader, Subject B, who is also the slowest reader of the numerals. His case appears to be very exceptional and no adequate explanation is found in the records, nor was the subject himself able to account for his relatively high speed with words. After B, the two partial readers, G and M, have the fastest records. The slowest record was made by the whole first reader H. By virtue of relatively higher speeds with both numerals and words the partial first readers completed the first reading of the problems in shorter total reading-times than the whole readers.

TABLE XXIII

READING OF WORDS IN PROBLEMS BY PARTIAL FIRST READERS CONTRASTED WITH READING OF WORDS IN PROBLEMS BY WHOLE FIRST READERS

(Time unit = 1/50 of a second)

	SUBJECTS					
	Partial First Readers			Whole First Readers		
	G	M	W	B	H	Hb
Total time required to read all words of problems...	708	800	925	560	1092	923
Total number of pauses required to read all words of problems..................................	66	81	71	61	93	84
Average pause-duration..........................	10.72	9.87	13.02	9.18	11.74	10.99

NOTE.—Each subject read all five problems which included 111 words.

Another basis may be found upon which significant inferences can be drawn as to the relative value of the two methods of first reading of numerals. It is possible to draw a comparison between the several individuals, who use the one or the other of the two methods, in respect to their rates of reading with reading materials other than arithmetical problems. Stated in other terms the point in question is: Which of the two methods was used by the readers who exhibit higher rates of reading in other materials. The data concerning the rates of speed with which the subjects read the ordinary prose selection may be used in this comparison. With these materials the average reading-time per line for subjects M and G were 44.88/50 and 52.52/50 seconds, respectively, and for subjects W, H, and B they were 75.21/50, 75/50, and 80.78/50 of a second, respectively. It is clear, therefore, that the faster readers of the ordinary prose selection used the partial method of reading numerals on the first reading, and two of the three slower readers of the ordinary prose used the whole method of reading numerals.

The more rapid reading of the partial first readers is due to the fact that for the most part they used fewer pauses in reading the same materials than the whole readers. Such is the explanation of the greater speeds whether the materials which were used were the numerals or words of a problem, or the lines of the ordinary prose selection. A smaller number of pauses also explains the exceptionally short total reading-time of Subject B on the words of the problems.

6. DEVELOPMENT OF THE METHOD OF PARTIAL FIRST READING

The large differences between the methods of partial and whole first reading in the several important respects to which attention has been directed in this immediate study and in previous studies of the investigation can be satisfactorily explained only in the light of large differences in attitude on the part of the individuals who use respectively the one or the other of the two methods. The evidence is strong that partial and whole first readers entertain very different attitudes toward the numerals when the problem is being read for the first time. The fact that such differences between the two groups do exist does not necessarily imply that the members of either group are conscious, either of their own peculiar attitude, or of the existence of a different attitude. Most of the subjects of the investigation were not conscious of their attitudes. The implication is, rather, that through long experience with problems these subjects have developed in an empirical way two widely differing sets of habits of reading numerals during the first reading of a problem.

When first learning to read numerals in problems, these subjects, as most individuals probably do, proceeded to read the numerals very slowly, as they came to them, and one digit at a time. The whole reading attitude toward numerals would, therefore, be the attitude more natural for beginners in reading arithmetical problems. In the course of extensive experience, apparently, some of the individuals were more impressed than others, with the differences between words and numerals in respect to the rates of speed which were found practicable in reading them. These individuals were thus stimulated to learn a new method of procedure with the numerals, which would make for a quicker disposition of them in reading problems. Such a new procedure could not consist simply of a radical increase of the span of perception to include larger units of recognition, as had been done with word materials when whole words and phrases came to be taken as units of perception. Perception of the larger numerals by numeral wholes appears to be quite impracticable because of the nature of numerals as continually varying combinations of digits.

The plan that was learned consists of a rapid passage over the numeral during which time details are skipped and only the most outstanding facts concerning it are gathered. Such is the procedure which is designated as partial first reading and in preliminary sections of the investigation the identity of the first digit of a numeral and recognition of the number of its digits were found to be facts of the outstanding nature referred to. Various ranges of partial first reading came to find empirical acceptance in the course of the development of the habit of partial reading by the natural trial-and-error method of learning. Such changes in procedure were probably able to be accomplished with little or no embarrassment to individuals in the practical solving of problems because of the almost invariable habit of re-reading the numerals after the first reading of a problem.

7. SUMMARY OF CONCLUSIONS

The chapter may be summarized as follows:

1. The numerals of problems make greater demands upon the attention of readers than do the accompanying words, as is shown by the following facts: (*a*) The average number of digits included by a pause on numerals is decidedly smaller than the average number of letters included by a pause on words. (*b*) The average duration of pauses on numerals is greater than the average duration of pauses on words in the cases of all subjects. (*c*) The percentage of regressive pauses on numerals is greater than the percentage of such pauses on words. The explanation of the greater demands of the numerals probably lies in the fact that the combinations of digits in numerals are continually different, whereas combinations of letters in words remain stable.

2. More pauses per numeral and greater total reading-times per numeral are required for whole first reading of numerals than for partial first reading.

3. Shorter numerals are given whole first readings almost invariably. Longer numerals, on the other hand, are given whole or partial readings according as the subjects who read them are whole or partial readers.

4. The numeral 1000 is regularly read as if it were a word rather than a numeral.

5. The subjects divide themselves into groups of partial first readers and of whole first readers according as they read the longer numerals by the partial or whole method.

6. The partial method is more economical than the whole method in point of total time required to read the numerals during the first reading of a problem.

7. The subjects who read the ordinary prose selection more rapidly use the partial method of reading the longer numerals for the most part.

8. The more rapid rates of reading in both the words and numerals of problems and in the ordinary prose selection are exhibited by subjects who use the smallest number of pauses in such readings.

9. Partial first reading of numerals is probably learned empirically as a method of more rapidly disposing of the numerals in reading. The essential characteristics of the method are skipping the details of a numeral and recognizing only the most outstanding facts concerning it.

CHAPTER VIII

RE-READING AND COMPUTATION

I. TWO TYPES OF RE-READING OF NUMERALS

Re-reading from a problem takes place immediately upon completion of the first reading. Two distinct types of re-reading of numerals appear. The two types are distinguished by differences in function. In some cases such differences are disclosed directly by reports which were made by the subjects themselves upon the basis of introspective observations as to what numerals were re-read and why they were so re-read. In other cases definite evidence as to which type of re-reading was used is found by careful examination of the readings as they are described in the plates.

The first type, which may be called simple re-reading, has as its function, apparently, the gathering of further information concerning the numerals before a decision has been reached as to what plan will be followed in solving the problem. Only one of the numerals of a problem is re-read after this fashion. A single case of exception was found in the reading of Problem 5 by Subject Hb when two numerals were re-read in this way. The implication is that such re-reading is undertaken only when the subject is definitely interested in some specific detail of a certain numeral. According to the reports of subjects these specific details include various items of verification of numerals such as the identity of certain digits, the number of digits in the numeral, and the location of the numeral within the line.

The type of re-reading which was given a numeral is indicated in Table XXIV in all cases but two. The two exceptions are with the readings of problems 2 and 3 by Subject M. In these instances several of the words of the problems were re-read along with the numerals. Because of this fact interpretation of the records was complicated to such an extent as to make it impossible to distinguish with certainty which type of re-reading was given the numerals.

Instances of simple re-reading are described in detail in plates I, II, III, V, and XI. The numeral 1000 was given such a re-reading by four of the subjects; illustrations are found in plates I and II. Subject Hb gave a re-reading of the simple type to numerals in each of the last four problems, and an illustration of his procedure in the case of

TABLE XXIV

TYPE OF RE-READING GIVEN TO NUMERALS, OR TO NUMERALS AND WORDS, BEFORE BEGINNING OF COMPUTATION

Subjects	Problem				
	1	2	3	4	5
Hb............	Re-read and copied 47	Re-read 357 Re-read and copied 1643 Re-read and copied 357	Re-read 243,987 Re-read and copied 243,987 Re-read and copied 21,767	Re-read 1000 Re-read and copied 1276 Re-read and copied 91 Re-read and copied 817	Re-read 1,918,564 Re-read 617,453 Re-read and copied 1,918,564 Re-read and copied 617,453
M.............	Re-read some of the words and the numeral 2	Re-read some of the words and numerals and copied the numerals	Re-read some of the words and numerals and copied the numerals	Re-read 1000 Re-read and copied 1276, 91,817 Re-read and copied 1000	Re-read and copied 1,918,564 Re-read and copied 617,453
W.............	Re-read 47 and 2	None	None	None	None
H.............	None	None	None	None	None
B.............	None	None	None	Re-read 1000	None
G.............	None	None	None	Re-read 1000	None

NOTE.—Two types of re-reading are distinguished in the table. (1) Simple re-reading, such as was given the numeral 243,987 in Problem 3 by Hb, is designated by "Re-read 243,987." (2) Re-reading for copying, which was done in the case of the numeral 1643 in Problem 2 by Hb, is designated by "Re-read and copied 1643." "None" in the columns signifies that no re-reading was done.

Problem 2 appears in Plate V. In Plate XI is found an instance of simple re-reading of the numeral 2 along with certain words of the problem by Subject M.

The second type of re-reading of numerals is that for the purpose of copying the numerals on to the problem card. In the case of each re-reading so classified the records show that the subject after he had re-read the numeral, proceeded immediately to copy it on the problem card. Such re-reading was the normal procedure for subjects Hb and M as is shown in Table XXIV. More detailed descriptions of re-readings of this type are found in plates V, VI, and VII. The record of Subject M, which is presented in Plate VI, shows a distinct variation from the procedure of re-reading as described above. Subject M re-read the numeral 1,918,564 by the four pauses, 24 to 27, inclusive, and at the same time copied the numeral in the vicinity of pauses 32 to 34, without moving his eyes from it during the process of re-reading and copying.

Whether a numeral was or was not re-read depended upon the habits of individual subjects rather than upon either the length of the numeral or upon the quality of first reading which it had received. Numerals of all digit-lengths, including both those which had received whole first readings and those which had received partial first readings, were re-read. Re-reading was practiced systematically both by subjects Hb and M, the former of whom was classified as a whole first reader and the latter as a partial first reader. Of the four subjects who almost invariably proceeded without re-reading, two were classified as whole first readers and two as partial first readers.

Attention should be called at this point to the marked differences between the small proportion of re-readers of numerals, as reported immediately above, and the fact that all subjects re-read most of the numerals of the problems which were used in the first preliminary study. Subjects G and H who with only one exception did not re-read the numerals in the present study did, however, persistently re-read the numerals of the problems of the first preliminary study. In subsequent paragraphs, re-reading is found to be closely connected with the procedure of copying the numerals on paper for computation with pencil. With only occasional exceptions this procedure was followed regularly by all of the subjects in the first preliminary study, including subjects G and H. It is probable, therefore, that their persistent re-reading in the first study was done for the most part in order to insure accuracy in copying the numerals on the computation paper.

2. METHODS AND PROCEDURES USED IN THE PROCESS OF COMPUTATION

Two distinct methods of computation were exhibited by the subjects in respect to their procedure with the numerals immediately after the first reading of a problem. In one case two of the subjects re-read and copied the numerals on the problem card, and wrote out on the card with pencil the figures used in the process of computation. In the other case, four of the subjects computed "mentally" and directly from the numerals as they were printed on the problem card. The former may be called computation from copied figures and the latter, computation direct from the problem card. Table XXV shows which procedure was followed with each problem by each of the several subjects.

TABLE XXV

Two Methods of Proceeding with Numerals for the Purposes of Computation after the First Reading

Subject	Problem				
	1	2	3	4	5
Hb............	X	X	X	X	X
M............	Re-read 2 O	X	X	X	X
W............	Re-read numerals O	O	O	O	O
H............	O	O	O	O	O
B............	O	O	O	Re-read 1000 O	O
G............	O	O	O	Re-read 1000 O	O

Explanation of symbols—
"X" = re-read and copied numerals, and computed from copied numerals.
"O" = computed immediately and directly from the problem card without re-reading.

It is important at the beginning of the discussion of the two methods of procedure that the most essential difference between them be set forth clearly. The difference lies primarily in the number of mental steps involved in the two methods. At least two additional mental steps are required by the method of computation from copied figures, namely, re-reading of numerals and copying them on the computation card. The method of computation direct from the problem card avoids these two steps. A large pedagogical significance attaches to the elimination of two such mental steps. By their elimination it would appear that many opportunities for error are avoided and valuable economies of time and of mental and physical effort may be effected.

The description of the procedures which were used in computation that follows, is concerned only with such procedures as were exhibited by the subjects who computed directly from the problem cards. It was found impossible to interpret precisely the records of eye-movements over copied figures in respect to the location of the pauses on the figures. The processes of computation could be followed to the solution of the problem in only a limited number of the records even of those subjects who used the method of direct computation.

The procedure of direct computation from the problem card appears to have been followed without regard to the quality of first reading which the numerals had received. Cases of direct computation are found as sequels both to partial first readings and to whole first readings of the numerals. In Plate XI direct computation is observed to have followed upon whole first readings of both numerals of the problem. Similar illustrations are found in plates VIII and X.

In Plate XII, however, the two numerals had been only partially read during the first reading. In this instance the numerals never were read completely at any reading. Similar cases were found with other subjects. Evidently for some subjects only a partial reading of the numerals of a problem is necessary for the successful use of such numerals in computation.

It is important to notice in this connection that the same subjects do not always use the same procedure in computing with different sets of problems under different conditions. Illustrations are found in the cases of subjects G and H. These two subjects used the method of direct computation with the "five problems," as reported immediately above. With the "seven problems" of the first preliminary study, however, they followed the procedure of computation from copied figures.

An explanation of these facts should begin with the very probable premise that these two subjects, who were adults and advanced graduate students, were able to follow successfully either procedure in solving such simple arithmetical problems as were used in this investigation. The method of direct computation was followed with greater facility with the "five problems" than with the problems of the first preliminary study because of the greater obviousness of the answers to the "five problems." The numerals of most of these problems had been so selected as to make the answers even numbers, or numbers with every digit the same, in order to minimize the labor of computation. It is probable also that the subjects worked at somewhat higher tensions when seated before the camera for solving the "five problems" than when seated at an ordinary desk for solving the "seven problems." Such higher tensions might well have influenced the workers to select the quicker direct method rather than the slower copying method of solving.

During the process of computation, the numerals, which are in the context of the problem and with which the computation is concerned, do not receive the same quality of attention from the subjects. This fact is most clearly in evidence when two numerals appear in the context of a problem. The records show that more pauses and pauses of greater average duration were located on the digits of one of the numerals than on the digits of the other numeral. In the cases of shorter numerals, pauses were located upon only one of the numerals, while the other numeral was retained in memory. By such unequal distribution of attention one of the numerals was, in effect, made the "base of operations" during the computation. Three examples of this procedure were found in the solving of the problems in which the shorter numerals appeared. The records appear in detail in plates III, VIII, and IX. In Plate IX, which will serve as an illustration, the numeral 357 was used as the "base of operations," while the numeral 1643 was held in memory.

An example of the same procedure with the longer numerals of Problem 3 is found in Plate XII. In this instance the numeral 243,987 was used as the "base of operations." Five pauses with an average pause-duration of 38/50 of a second were located on this numeral during the process of computation. On the other hand, on the numeral 21,765 only four pauses were located during the computation, and their average duration was only 28.75/50 of a second.

Two further examples of the procedure are found in the solution of Problem 5 by subjects H and G in plates XIII and XV. Interpretation of plates XIII and XV is complicated to a large extent by the presence in the records of a number of pauses which were not used strictly in the processes of computation. Such additional pauses were used apparently in locating the digits next in order for computation, or else they were used in directing the hand when it was engaged in recording figures of the answer. Such pauses, therefore, may be referred to as locating- and as recording-pauses respectively.

TABLE XXVI

Analysis of the Process of Computation in which One Numeral Is Used as the "Base of Operations"

(Time unit = 1/50 of a second)

Plate in which the record of the computation appears	XIII		XV	
Numerals which appear in the context of Problem 5 and with which the computation is concerned	1,918,564 ("Base of operations")	617,453	1,918,564 ("Base of operations")	617,453
Ordinal numbers of locating- and recording-pauses, as found on plate	38, 41, 48, 52, 53, 57	43, 47	28, 31, 34, 39, 43, 44, 45, 46	23, 26, 41
Ordinal numbers of computation pauses, as found on plate	39, 42, 45, 49, 54, 55, 58	40, 44, 46, 50, 51, 56	25, 29, 32, 35, 37, 40, 42	24, 27, 30, 33, 36, 38
Respective durations of computation pauses, as found on plate	11, 13, 24, 13, 30, 13, 36	23, 20, 17, 12, 20, 13	29, 10, 19, 20, 26, 26, 32	10, 9, 18, 26, 22, 23
Sum of the durations of computation pauses	140	105	162	108
Total number of computation pauses	7	6	7	6
Average duration of computation pauses	20.0	17.5	23.1	16.0

Note.—Pauses were distinguished as computation pauses, and as locating- and recording-pauses, upon the basis of the judgment of the author.

It was found impossible to distinguish the locating- and recording-pauses in plates XIII and XV from the computation pauses with absolute certainty. An effort was made, however, after a detailed study of the original reports of subjects H and G on their solutions of Problem 5, to separate the locating- and recording-pauses from the computation pauses. The result appears in Table XXVI. An inspection of the table shows that both subjects H and G used the numeral 1,918,564 as the "base of operations" during computation.

The longer numeral in five of the six cases, which are described above, was taken as the "base of operation." Such selection of the longer numeral is probably in keeping with the practice common in the solving of arithmetical problems which, when two numerals are arranged for computation, places the greater numeral first in order and relates the second numeral to the greater. The larger number of pauses upon the longer numeral, which at the same time is the "base of operations," is due to the fact that computation both begins and ends with the longer numeral, and to the further fact that in the longer numeral an additional digit appears for reading.

The large difference between the average duration of the pauses on the numeral which was used as the "base of operations" and the average duration of the pauses on the other numeral is significant of a difference in function between the two sets of pauses. The pauses on both numerals necessarily must use such time as is sufficient for recognition on the part of the reader of the digits with which the pauses are severally concerned. In addition to the work of recognitions, however, some of the pauses on the "base of operations" numeral evidently perform service in the more strictly arithmetical processes. For such service a greater pause-duration would undoubtedly be necessary.

3. SUMMARY

1. Two types of re-reading of numerals are distinguishable. Simple re-reading is concerned with verification of details of the numerals. Re-reading for copying is concerned with reading the numerals for copying on the computation card.

2. Two of the subjects normally re-read all of the numerals. The four other subjects normally do not re-read the numerals. Whether the numerals are or are not re-read depends upon the habits of individual subjects.

3. Two methods of proceeding with the numerals after the first reading are distinguishable. In the one, computation begins immedi-

ately and is carried on directly from the context of the problem. In the other case the numerals are re-read and copied, and the computation proceeds from the copied figures. By the former method, two mental steps are saved.

4. The method of immediate computation direct from the context of the problem is used without regard to whether the numerals have received a partial or a whole first reading.

5. During computation one numeral is taken as the "base of operations." A large number of pauses and pauses of greater average duration are located on the digits of this numeral than on the digits of the other numeral. The significance of the greater duration of such pauses probably lies in the additional work of the more strictly arithmetical processes which seems to have been done during these pauses.

CHAPTER IX

THE READING OF ISOLATED NUMERALS IN LINES

I. INTRODUCTION

As was stated in the introductory paragraphs of this report such attention as has been given to the reading of numerals in previous experiments in the psychology of reading has been incidental to other purposes. The numerals which were read in previous experiments were in each case isolated numerals in lines. Gray,[1] when investigating the perception span of good and poor readers, had a number of individuals read short lines of unspaced digits and groups of the same digit as well as selections of words with meaning. A summarizing paragraph at the end of his discussion contains the conclusion that differences between the span of attention of the good and poor reader disappear in a very large measure when digits or groups of the same digit are read.

Dearborn,[2] while interested chiefly in the span of attention and in the question as to whether perception proceeds by number wholes or by individual digits, had several subjects read lines of digits which were printed consecutively without spacing, and lines of numerals varying in length from two to six digits. In the records which were obtained from these readings he observed that the time required for reading the same number of unspaced digits in a line was greater when the subjects grouped the digits by fours than when they grouped the digits by threes. He noticed also that the time required for reading numerals increased with increases in the digit-lengths of the numerals. Attention was called, at the same time, to the larger number of "shifts" or "breaks" in the fixations on numerals than in the fixations on words, and the opinion was expressed that a single digit was probably sometimes the unit of perception in the two-digit numerals.

In a preliminary study of the present investigation, data were presented concerning the reading of numerals arranged in columns.

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[1] C. T. Gray, "Types of Reading Ability as Exhibited through Tests and Laboratory Experiments," *Supplementary Educational Monographs*, Vol. I, No. 5 (1917), p. 146.

[2] W. F. Dearborn, "Psychology of Reading: An Experimental Study of the Reading Pauses and Movements of the Eye," *Columbia University Contributions to Philosophy and Psychology*, Vol. XIV, No. 1. New York: The Science Press, 1906. See chapter x, "The Number Span of Attention," pp. 67–73.

In that study special attention was called to the fact that the digits of the numerals were read in groups. The purpose of the present study is to examine in detail the readings of a representative number of numerals of each of the several digit-lengths of from one to seven digits. Variations in the readings of the numerals of the several lengths are reported and the reading habits, which were exhibited by individual readers, are described. The records of the movements of the eyes of the subjects while engaged in reading numerals are given in plates XVI–XXV, and the data from the records are condensed and arranged in tables XXVII–XXXI.

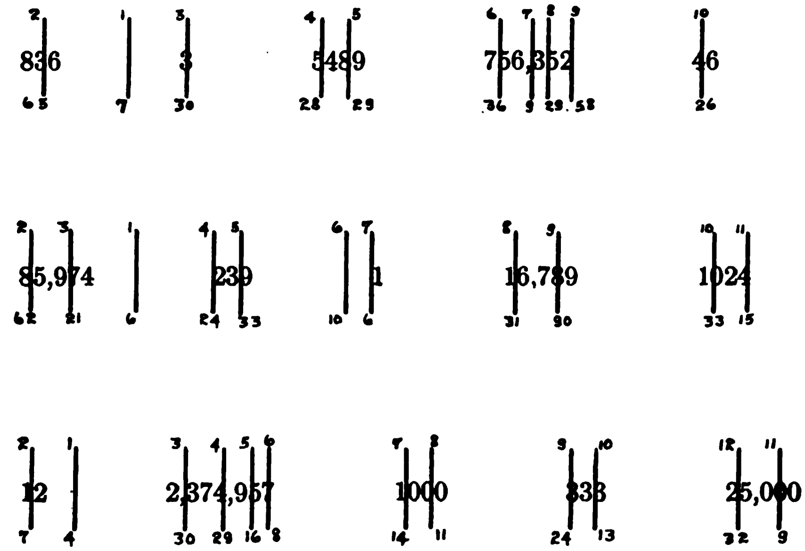
In the plates the variations in length of the vertical lines above and below the lines of printed numerals were provided merely for convenience in drawing in the numbers of the various pauses.

When the initial pause of a line did not fall on one of the digits of the first numeral in the line, such a pause was not included in the tables. When an initial pause fell on the first numeral of a line and was followed by a regressive movement, such a pause was not counted in the tables. It is obvious that counting pauses of the latter sort would have given in each case an additional pause to the first numeral in the line merely because of its position as first numeral in the line.

In plates XVI and XVII the reading of isolated numerals by Subject G is represented. At the beginning of each line of numerals an initial regressive movement was found necessary in the effort to locate the first digits of the first numeral. Subject G reads with relatively few pauses, but with pauses of relatively long duration. The pauses vary widely in duration; the range of variation extends from 4/50 to 90/50 seconds with the average duration at 33.88/50 of a second. Single pauses, when they are located on the longer numerals, tend to perceive two or three digits rather than one or two. In three instances the subject accomplished the remarkable feat of reading four digits during a single pause. The three instances are found in Plate XVII; two are in the first line with the numerals 9317 and 5,236,795; and the third is in the second line with the numeral 1928.

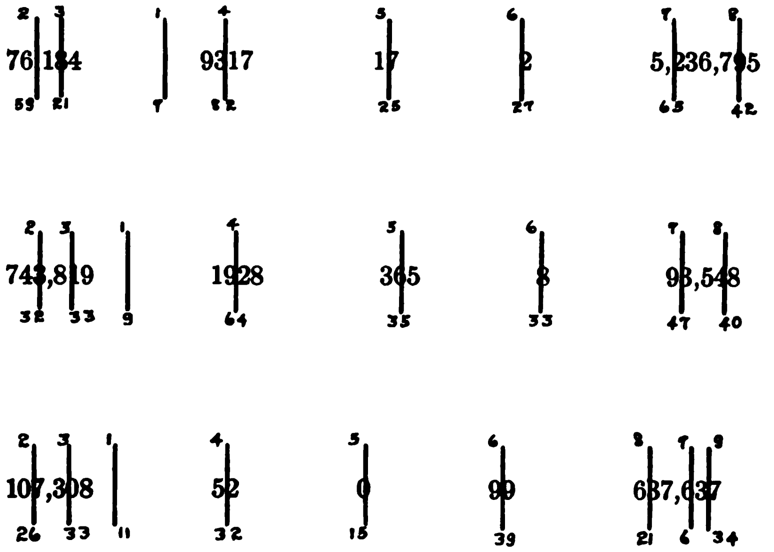
In plates XVIII and XIX appear the readings of isolated numerals by Subject H. This subject read with a relatively large number of pauses, but with pauses of relatively short duration. The pauses varied in duration from 4/50 to 56/50 seconds. The average duration, which was 19.32/50 of a second, was shorter than that of any other subject. Many short guiding-pauses appear. Single pauses, even when they are located on the longer numerals, tend to include only

PLATE XVI



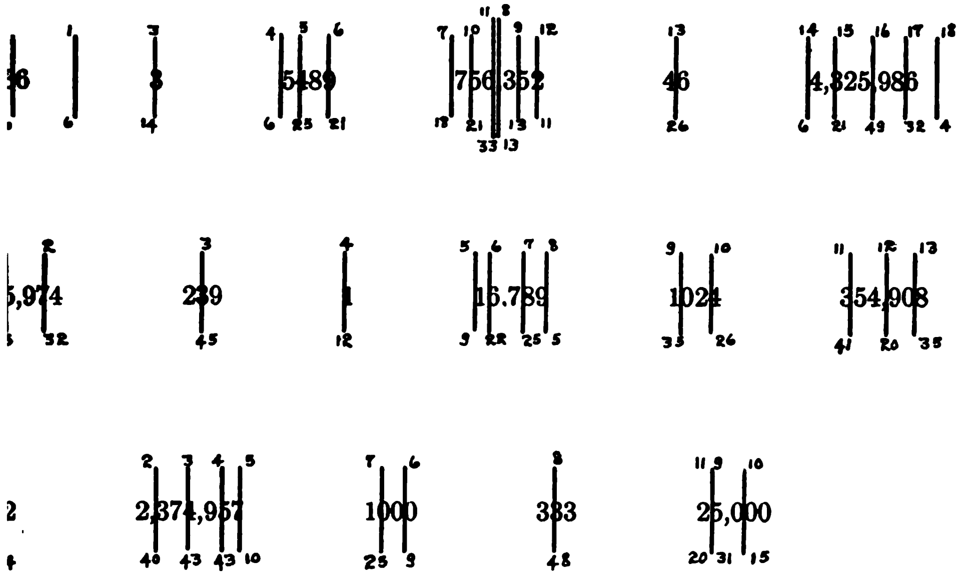
Reading of isolated numerals by Subject G

PLATE XVII



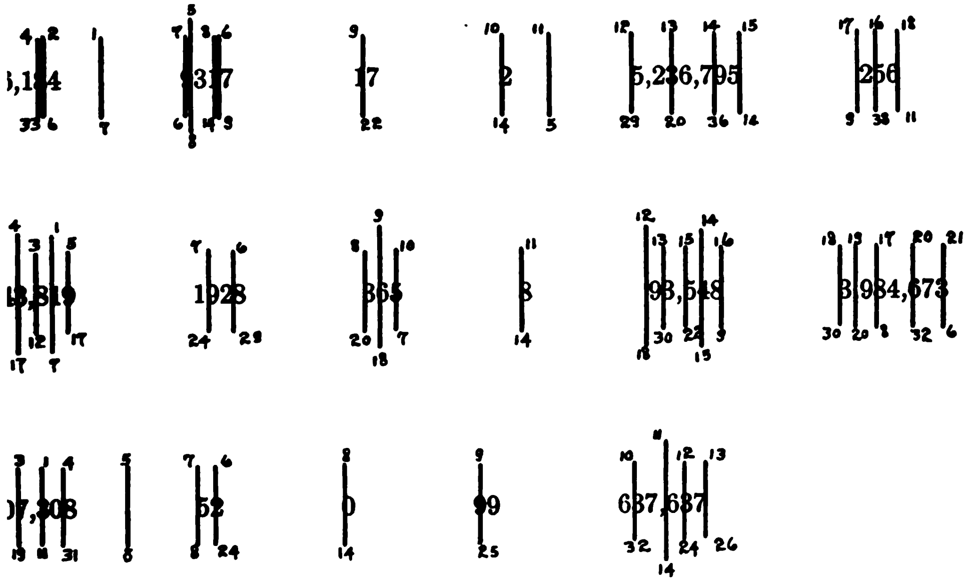
Reading of isolated numerals by Subject G

PLATE XVIII



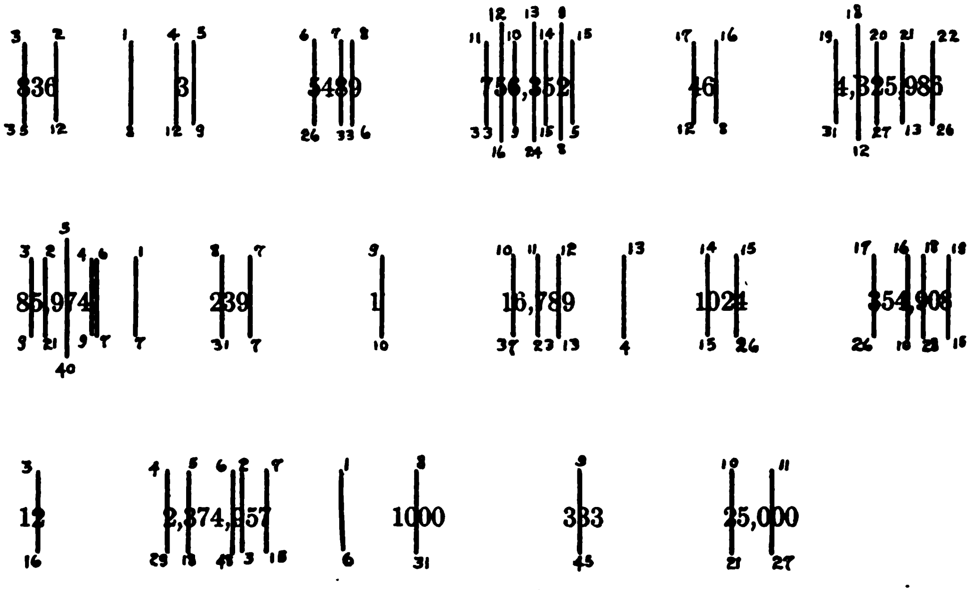
Reading of isolated numerals by Subject H

PLATE XIX



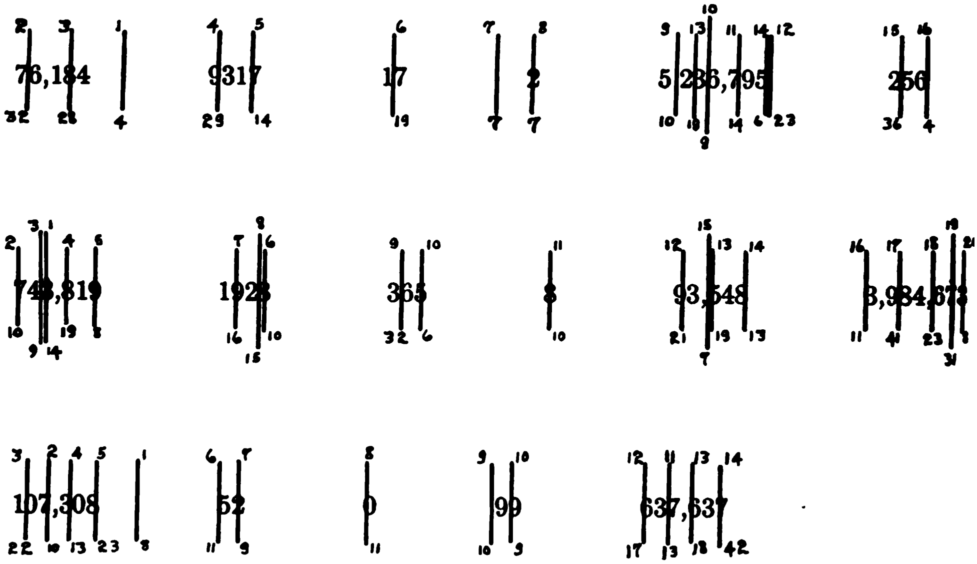
Reading of isolated numerals by Subject H

PLATE XX



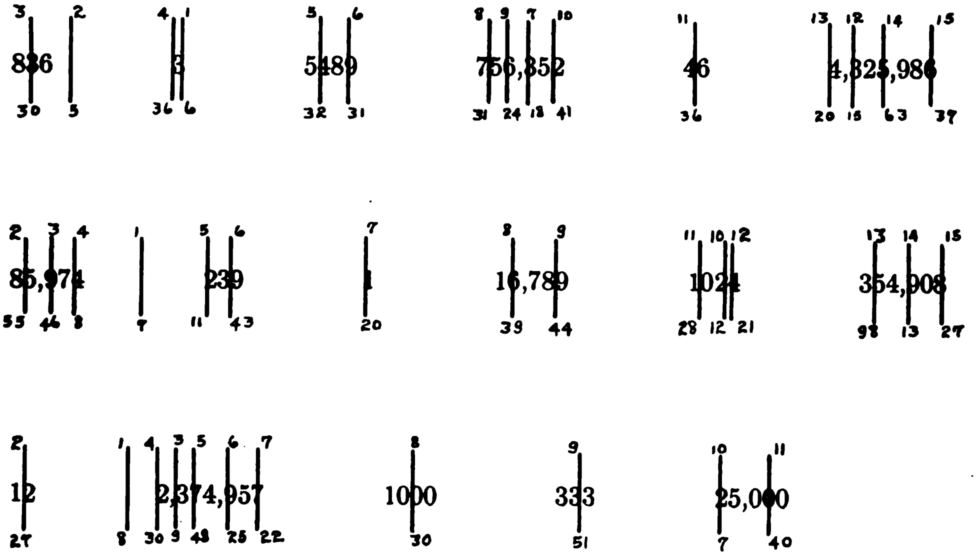
Reading of isolated numerals by Subject M

PLATE XXI



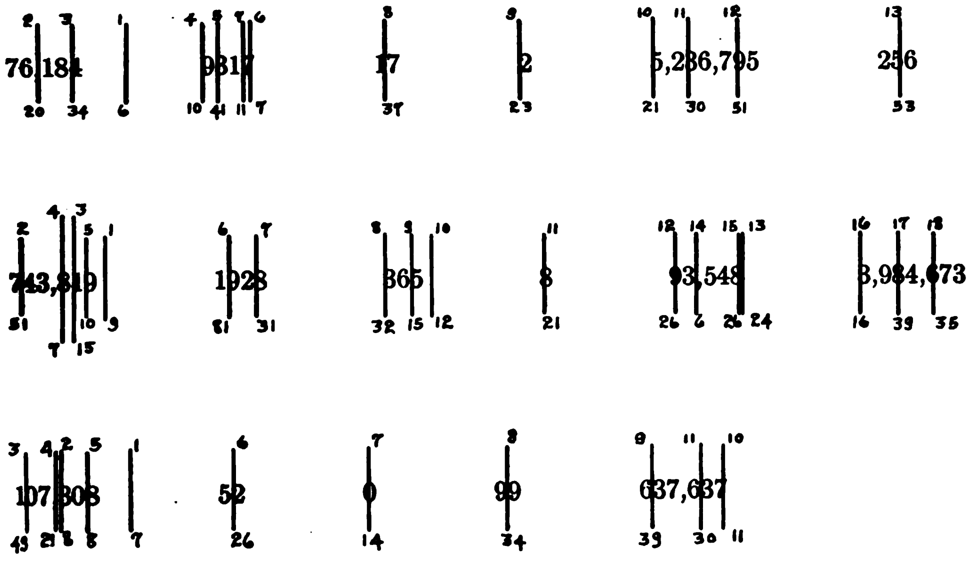
Reading of isolated numerals by Subject M

PLATE XXII



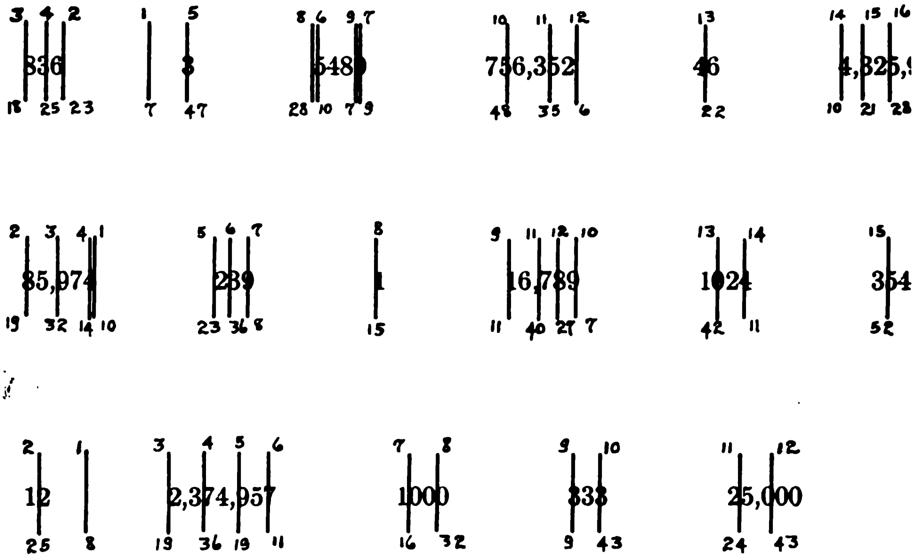
Reading of isolated numerals by Subject B

PLATE XXIII



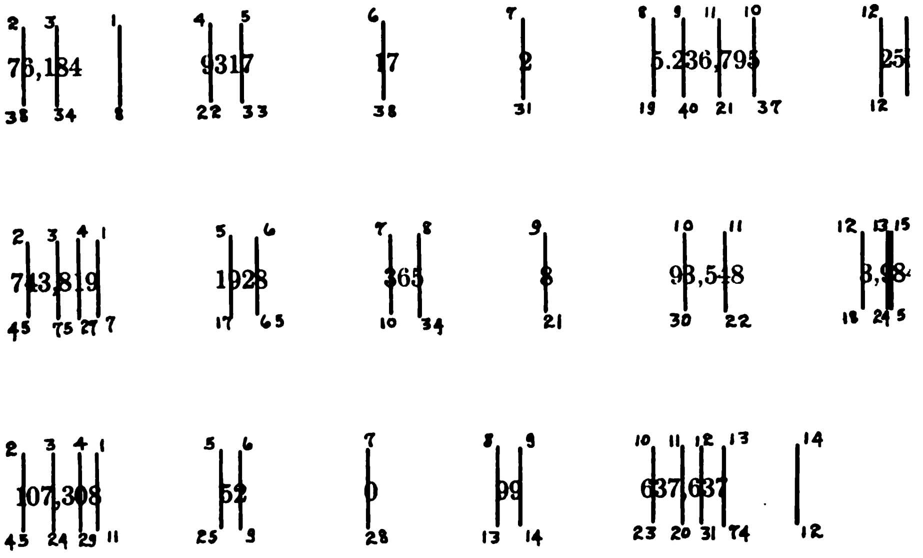
Reading of isolated numerals by Subject B

PLATE XXIV



Reading of isolated numerals by Subject W

PLATE XXV



Reading of isolated numerals by Subject W one or two digits at a pause. The readings, which were given the numerals 756,352 in Plate XVIII and 93,548 in Plate XIX, are illustrations of very detailed reading. The readings given the last three numerals on Plate XVIII, the special numerals 1000, 333, and 25,000 show fewer pauses than H gave to other numerals of like lengths. He evidently read 1000 as a whole. A relatively large number of regressive pauses is found on these plates.

The readings of Subject M are described in plates XX and XXI. His methods of reading the numerals were similar to those of Subject H, to which attention was called in connection with plates XVIII and XIX. The total reading-time for all the numerals was less for Subject M than for any other subject, despite the relatively large number of pauses which he used. Several instances appear in these plates of short initial and final pauses on the same longer numerals. The readings of the numerals 4,325,986 and 16,789 in Plate XX and of 5,236,795 and 743,819 in Plate XXI illustrate such use of the guiding-pauses. The special numerals were read in the same manner as other numerals of like lengths. Plates XXII and XXIII record the reading of isolated numerals by Subject B. It appears that this subject's readings are irregular in respect to number of pauses on numerals of the greater lengths. Some of the longer numerals were read with few pauses. The numerals 5,236,795 and 3,984,673 in Plate XXIII are illustrations of this type, while the numerals 9317 and 743,819 on the same plate were read with a comparatively large number of pauses. The numeral 1000 was evidently read as a whole. Initial regressions appear consistently in each line.

The readings of isolated numerals by Subject W are presented in plates XXIV and XXV. A persistent use of two pauses appears in the readings of numerals of from three- to five-digit lengths. Two instances are seen in the numerals 5489 and 16,789 in Plate XXIV when even the re-readings of the numerals were done with pairs of pauses. Initial regressions occur consistently.

2. TWO TYPES OF PAUSES

When a detailed examination is made of the pauses with which the numerals were read, it appears that they represent two distinct types.

The two types are distinguished by differences in function. Pauses of the first type, which may be called strictly reading-pauses, were probably used in recognizing the identity of the digits of the numerals and the relations between the digits. Such pauses are invariably located on the numerals. Their durations are approximately equal to, or greater than, the average duration of the pauses of the subject whose records are under consideration. A preponderant number of the pauses of any subject are of this first type.

Pauses of the second type, which may be called guiding-pauses, were probably used in locating the first digits or the last digits of the numerals. They are found on the initial or final digits of numerals, and more frequently on numerals of greater digit-lengths. Some of these pauses appear on the lines between the numerals. The first pause in any line was almost invariably of this type and of very brief duration when compared with other pauses. Subjects H and M used larger numbers of pauses of this type than any of the other subjects.

3. DIFFERENCES IN THE READINGS OF NUMERALS OF DIFFERENT LENGTHS

Upon inspection of the last row of Table XXVII it is found that the average total reading-time per numeral increases steadily from an average of 21.45/50 of a second for the one-digit numerals to an average of 104.54/50 of a second for the seven-digit numerals. The same continual increase is found almost without exception in the rows of the several subjects. Likewise the average number of pauses per numeral, when the records of all subjects are averaged, increases steadily from the average of 1.15 pauses on one-digit numerals to the average of 4.15 pauses on seven-digit numerals. It is clear therefore that the total reading-times and the number of pauses which were required to read a numeral, depended upon its digit-length.

The average duration of the pauses, on the other hand, does not depend upon the length of the several numerals in the same consistent fashion as does the average number of pauses per numeral. The details may be found in Table XXVIII, where it is seen that both in the rows for individual subjects as well as in the row which presents averages for all of the subjects, the average pause-duration not only fails to increase steadily with increasing lengths of the numerals but in several cases actually decreases.

With three of the subjects, M, H, and G, on the other hand, the average duration of the pauses increases steadily from that of the numerals of one digit to that of the numerals of three digits. Two of these three subjects, M and G, however, as may be observed in Table XXIX, read the one, two, and three digits of the one-, two-, and three-digit numerals, respectively, for the most part with a single pause. In the case of Subject B, also, a steady increase in pause-duration is found when the one-, two-, and three-digit numerals were read at single

TABLE XXVII

Average Number of Pauses and Average Reading-Time per Numeral for Isolated Numerals

(Time unit = 1/50 of a second)

Subject	Average per Numeral	Digit-Length of Numerals						
		1	2	3	4	5	6	7
M	Number of pauses	1.25	1.25	1.5	2.5	3.0	4.5	5.0
	Reading-time	12.5	22.25	44.75	49.25	64.5	83.25	110.75
H	Number of pauses	1.25	1.5	2.5	2.75	4.0	4.75	4.5
	Reading-time	14.75	25.0	47.0	49.0	81.0	90.25	103.5
G	Number of pauses	1.25	1.0	1.25	1.5	2.0	2.5	3.25
	Reading-time	26.5	25.0	47.0	62.75	92.75	78.5	99.7
W	Number of pauses	1.0	1.25	2.5	2.5	2.75	3.0	4.25
	Reading-time	28.5	39.75	52.5	61.0	68.5	113.0	93.5
B	Number of pauses	1.0	1.0	1.75	2.75	2.75	3.75	3.75
	Reading-time	25.0	31.5	49.0	76.25	82.0	105.25	115.25
All Subjects	Number of pauses	1.15	1.2	1.9	2.4	2.9	3.7	4.15
	Reading-time	21.45	28.7	48.05	59.65	77.75	94.05	104.54

Note.—Each subject read four of each of the one-digit, two-digit, ... seven-digit numerals.

TABLE XXVIII

Average Pause-Duration of Isolated Numerals of the Several Digit-Lengths

(Time unit = 1/50 of a second)

Subject		Digit-Length of Numerals						
		1	2	3	4	5	6	7
M	Average pause-duration	10.0	17.8	29.8	19.7	21.5	18.3	22.2
	Average variation	2.3	6.2	16.6	7.5	9.4	6.8	12.0
	Total number of pauses	5	5	6	10	12	18	20
H	Average pause-duration	11.8	16.6	18.8	17.8	20.3	19.0	23.0
	Average variation	1.8	4.7	9.8	8.9	10.6	6.7	9.0
	Total number of pauses	5	6	10	11	16	19	18
G	Average pause-duration	21.2	25.0	37.6	41.8	46.4	31.4	30.6
	Average variation	9.4	3.8	11.8	20.8	18.1	8.9	11.5
	Total number of pauses	5	4	5	6	8	10	13
W	Average pause-duration	28.5	23.8	21.0	24.4	24.9	37.6	22.6
	Average variation	10.5	6.6	9.0	14.0	9.2	12.8	7.0
	Total number of pauses	4	5	10	10	11	12	17
B	Average pause-duration	25.0	31.5	28.0	27.7	29.8	28.1	30.7
	Average variation	5.3	5.0	13.1	14.1	12.5	17.2	11.9
	Total number of pauses	4	4	7	11	11	15	15
All Subjects	Average pause-duration	19.3	22.9	27.0	26.3	28.4	26.9	25.8

Note.—Each subject read four each of the one-digit, two-digit, ... seven-digit numerals.

TABLE XXIX

NUMBER OF ISOLATED NUMERALS OF THE SEVERAL DIGIT-LENGTHS WHICH WERE READ WITH VARIOUS NUMBERS OF PAUSES PER NUMERAL

Digit-length of numerals	1		2		3			4				5					6							7						
Various numbers of pauses per numeral with which the numerals were read	1	2	1	2	1	2	3	1	2	3	4	1	2	3	4	5	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Subject M	3	1	3	1	2	2	..	..	2	2	..	..	2	..	2	..	..	..	1	1	1	1	..	..	..	..	1	2	1	..
Subject H	3	1	2	2	..	2	2	..	2	1	1	..	..	2	..	2	..	..	..	3	..	..	1	..	..	..	2	2	..	..
Subject G	3	1	4	..	3	1	..	2	2	..	..	..	4	..	..	..	..	3	..	1	..	..	..	..	1	1	2	..	..	..
Subject W	4	..	3	1	..	2	2	..	3	..	1	..	2	1	1	..	..	..	4	..	..	..	..	..	..	..	3	1	..	..
Subject B	4	..	4	..	2	1	1	..	2	1	1	..	2	1	1	..	..	..	1	3	..	..	..	..	..	2	1	1	..	..
Total for all subjects	17	3	16	4	7	8	5	2	11	4	3	..	10	4	4	2	..	3	6	8	1	1	1	..	1	3	9	6	1	..

NOTE.—Each subject read four each of the one-digit, two-digit, ... seven-digit numerals.

pauses. It is evident, therefore, that with certain subjects and to this limited extent, the pause-duration does increase with increases in the number of digits read.

Numerals of the same length exhibited a notable consistency in the number of pauses with which they were read by the several subjects. As may be observed in Table XXIX two different numbers of pauses include the number of pauses used in reading a preponderant number of the numerals of each length. The one- and two-digit numerals were read for the most part by single pauses. One and two pauses were used with the three-digit numerals and two and three pauses with the four- and five-digit numerals in most cases. The longer numerals exhibit more variety in the number of pauses with which they were read. With these numerals, the habits of individuals seem larger deciding factors than the tendency to a conventional number of pauses.

4. THE SPECIAL NUMERALS

The six special numerals, 0, 99, 333, 1000, 25,000, and 637,637, were included among the other numerals, in order that data might be obtained concerning such variations in the readings of numerals, as might be due to familiarity and to regularity in form on the part of the numerals read. The data for the two special numerals 1000 and 25,000 show consistent and significant variations from the data which represent the readings of ordinary numerals of like lengths. As may be observed in Table XXX the two numerals 1000 and 25,000 exhibit markedly shorter average reading-time per numeral, average number of pauses per numeral, and average pause-durations, than the ordinary numerals of the same lengths with which they are compared.

TABLE XXX

READING OF SPECIAL NUMERALS COMPARED WITH READING OF OTHER ISOLATED NUMERALS OF CORRESPONDING DIGIT-LENGTHS

(Time unit = 1/50 of a second)

Special numerals	0	99	333	1000	25,000	637,637
Corresponding digit-lengths of other isolated numerals with which the special numerals are compared	1	2	3	4	5	6
Average reading-time per numeral:						
Special numerals	16.4	30.8	46.6	33.6	53.8	93.0
Other numerals	21.45	28.7	48.05	59.65	77.75	94.05
Average number of pauses per numeral:						
Special numerals	1.0	1.40	1.40	1.6	2.6	4.50
Other numerals	1.15	1.2	1.9	2.4	2.9	3.7
Average pause-duration:						
Special numerals	16.4	22.0	33.29	21.0	24.46	25.82
Other numerals	19.3	20.86	27.04	26.28	28.43	26.88

NOTE.—Each subject read each special numeral once, and at the same reading with the other isolated numerals.

Each of the two numerals represents the special quality of regularity of form and the quality of familiarity which were described in the discussion of the numeral 1000 in chapter vii. Regularity of form, in what may be called common fashion as distinguished from the special fashion of regularity which has been described for the numeral 1000, is a quality of the other special numerals 99, 333, and 637,637. Such regularity of form, however, did not seem to be significant enough to affect important variations in the readings of those numerals. This immediate fact and the facts which are noted above appear in re-enforcement of the conclusion reached regarding the numeral 1000 in chapter vii. Evidently the qualities of special regularity of form and familiarity are influential factors in the reading of numerals, even when the numerals are isolated in lines.

5. TWO METHODS OF ATTACK IN READING NUMERALS

Two distinct methods of attack were used by different subjects in reading the numerals. By one method a relatively large number of pauses of relatively short average duration were used in the readings, and by the other relatively few pauses of relatively long average duration were used. The contrast between the two methods is sharply outlined by differences in the data for subjects H and G, who represent the first and second methods respectively, as such data are arranged in Table XXXI. Subject M also read by the first method and subjects W and B by the second method. In plates XVIII and XIX a relatively large number of guiding-pauses are found, while comparatively few appear in plates XVI and XVII. The shortest total reading-times for the whole

TABLE XXXI

SPEED AND THE TWO METHODS OF ATTACK USED IN READING ISOLATED NUMERALS

(Time unit = 1/50 of a second)

Methods of attack	Many Pauses of Short Average Duration		Fewer Pauses of Longer Average Duration		
Subjects	M	H	G	W	B
Total reading-time for all numerals	1549	1642	1728	1797	1937
Total number of pauses used in reading all numerals	76	85	51	69	67
Average pause-duration	20.38	19.32	33.38	26.04	28.92

NOTE.—Each subject read four each of the one-, two-, three-, ... and seven-digit numerals or a total of twenty-eight numerals.

set of isolated numerals are found in the records of subjects M and H who used the many-short-pauses method of attack in their readings.

The number of digits which are read at a single pause depends upon the method of attack which the subject uses, and upon the number of digits which a numeral offers for reading. Subjects M and H, who use the method of many short pauses, tend to perceive one and two digits at a pause. Subjects G, B, and W, on the other hand, who use the method of few and long pauses, tend to perceive two and three digits at a pause. The one and two digits of the one- and two-digit numerals were almost invariably read by single pauses by all subjects. In all of the plates which describe the readings of M, G, W, and B instances are to be found among the readings of the longer numerals in which as many as three digits were read at a pause.

In only three instances, however, when the special form numeral 1000 is not brought into consideration, as many as four digits are known to have been read at a single pause. All three of the instances are in the readings of Subject G and are reported on Plate XVII. Two instances occur on the four-digit numerals 9317 and 1928, and the other on the seven-digit numeral, 5,236,795. Evidently the reading of four digits at a single pause is very exceptional and it is significant that it occurs only in the records of the subject, who used the smallest number of pauses with the greatest average duration.

6. SUMMARY

1. Two types of pauses are distinguished by differences in duration. The strictly reading-pauses are probably used to recognize the identity of the digits of the numerals, and the relations between them. The guiding-pauses are used probably in locating the initial and final digits of numerals.

2. The average total reading-time per numeral and the average number of pauses per numeral increase gradually from the averages of the one-digit numerals to the averages of the seven-digit numerals.

3. With three subjects the average duration of pauses increased with increases in the number of digits read by the pauses.

4. Two different numbers of pauses include the number of pauses used in reading a preponderant number of the numerals of each length. The greatest consistency in this respect is found in the numerals of from one to five digits in length.

5. The quality of familiarity, rather than the quality of regularity of form reduced the average number of pauses and the total reading-

times of the numerals 1000 and 25,000 below the averages of ordinary numerals of like lengths.

6. Two distinct methods of attack are used in reading numerals. By the one method a relatively large number of pauses of relatively short average duration is used, and by the other method relatively few pauses of relatively long average duration are used. The subjects who employed the former method read the numerals in shorter total reading-time.

7. The usual number of digits read per pause is one or two, or two or three according to the habits of the subject who is reading. One subject is able to read as many as four digits at single pauses.

CHAPTER X

COMPARISONS OF RATES OF READING

I. COMPARISON OF THE SUBJECTS OF THE PRESENT INVESTIGATION WITH THE SUBJECTS OF SCHMIDT'S INVESTIGATION IN RESPECT TO RATES OF READING

Attention has been called in previous sections of this report to the fact that larger numbers of pauses of relatively greater average duration were used in reading the arithmetical problems than are commonly used in reading ordinary prose materials. It was decided, therefore, to test the reading-speeds of the several subjects of the present investigation with a different type of reading-material. The data, which were thus obtained, could then be compared with other data which represented he reading-speeds of similar individuals with similar materials.

The type of material, which was selected as most appropriate for this purpose, was that of ordinary expository prose. The text of the selection was taken from Judd's *Psychology of High-School Subjects*, a volume which was familiar in a general way to all of the readers. The data obtained with this material were to be compared with the results reported by Schmidt[1] in a previous investigation of the reading of "light passages from James's *Psychology*"[2] by 45 "adults, mostly graduate and undergraduate students."[3]

The conditions which governed the readings of the two selections were similar for the most part. In one respect, however, an important difference obtained. In Schmidt's investigation the subjects were instructed to "read rapidly for the thought."[4] In the present investigation, out of deference to purposes which are stated in the latter part of this chapter, the subjects were instructed to read for a "clear understanding" and at "normal speed." Further details concerning this material and the conditions under which it was given appear in chapter vi.

In order to facilitate the comparison certain rearrangements of the data as originally reported by Schmidt were made. The time unit used in his investigation was the sigma, or 1/1000 of a second. Figures which represented duration of time in this unit were converted into other figures representing the same durations in units of 1/50 of a second. By multiplying average pause-duration by average number of pauses per line figures were obtained for the average reading-time per line. In this way a single number is found to represent rates of reading. The data from the two investigations are arranged in Table XXXII.

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[1] W. A. Schmidt, "An Experimental Study in the Psychology of Reading," *Supplementary Educational Monographs*, Vol. I, No. 2 (1917), p. 42.

[2] *Ibid.*, pp. 32, 50.

[3] *Ibid.*, p. 34.

[4] *Ibid.*, p. 28.

When the data in Table XXXII are compared it is found that the subjects of the present investigation read at conspicuously higher rates, as judged by average reading-time per line, than the subjects of Schmidt's investigation. The superiority in speed on the part of the former subjects is due in largest measure to the decidedly shorter average durations of their pauses, although they also used fewer pauses per line. The advantage in favor of the subjects of the present investigation is emphasized by the fact that they were reading under instructions which called for only "normal speed," whereas the other subjects read under the instructions, "read rapidly for the thought."

TABLE XXXII

SUBJECTS OF THE PRESENT INVESTIGATION COMPARED WITH THOSE OF SCHMIDT'S INVESTIGATION IN RESPECT TO SPEED OF READING

(Time unit = 1/50 of a second)

	SUBJECTS			
	Average Number of Pauses per Line[*]	Average Pause-Duration	Average Deviation	Average Reading-Time per Line[‡]
Of the present investigation (5 adults)	6.05	10.75	2.87	65.04
Of Schmidt's investigation (45 adults)	6.50	15.41[†]	3.93	100.17

[*] The line-length of the materials read by Schmidt's subjects was 90 mm.; that of the materials read by the subjects of the present investigation was 93 mm.

[†] Schmidt's results, which are reported by him in time units of sigma (1/1000 of a second), are here presented in time units of 1/50 of a second.

[‡] The average reading-time per line is obtained by multiplying the average number of pauses per line by the average pause-duration.

So large a number of adult cases was included in the investigation by Schmidt that the figures reported by him may be taken as representing reliable averages of the performances of such subjects. Upon the basis of comparison with the results thus reported it is concluded that the subjects of the present investigation may be classified as decidedly better than average adults in respect to speed of reading. The implication of the foregoing paragraphs and of this conclusion is obvious. The larger number of pauses of relatively greater duration, which was found in the readings of the problems, is due to the nature of the problems as a type of reading-material rather than to slow speeds on the part of the readers.

2. COMPARISONS OF RATES OF READING THE THREE TYPES OF READING-MATERIALS

Significant evidence of differences between types of reading-materials, and concerning the nature of the differences as well, may be secured by comparisons between the rates with which the subjects read the different types of materials. With such a purpose in view, comparisons were arranged between the data from the readings of the problems, of the isolated numerals, and of the ordinary expository prose selection. The conditions which governed the readings of all three types of materials were essentially similar in that they called for such kinds of reading as are most customary for the several types, and for "normal speed" on the part of the subjects. The data which were obtained are, therefore, representative of normal performances on the parts of the readers with these three types of materials. Table XXXIII was designed to facilitate the comparison.

TABLE XXXIII

COMPARATIVE DATA FROM READINGS OF FIVE PROBLEMS, ORDINARY PROSE, AND ISOLATED NUMERALS

(Time unit = 1/50 of a second)

	Subjects						Average for All Subjects
	G	B	M	W	H	Hb	
Average number of pauses per line on:							
The five problems (first reading)	6.66	7.25	8.41	7.25	9.83	9.08	8.08
The ordinary prose selection	4.71	7.50	5.20	6.20	6.66	......	6.05
Isolated numerals	......	......	......	......	......	......	....
Average number of letters, or digits, per pause on:							
The five problems (first reading)	6.61	6.08	5.24	6.08	4.48	4.85	5.56
The ordinary prose selection	9.61	6.03	8.69	7.38	6.75	......	7.69
Isolated numerals	2.28	1.66	1.48	1.62	1.31	......	1.67
Average duration of pauses on:							
The five problems (first reading)	11.28	11.95	10.93	13.44	12.11	11.58	11.88
The ordinary prose selection	11.15	10.77	8.63	12.13	11.25	......	10.75
Isolated numerals	30.57	28.62	19.85	26.11	18.18	......	23.80

NOTE.—Satisfactory data on the reading of ordinary prose and isolated numerals were not obtained from Subject Hb.

The average line-length of the five problems materials was 93.33 mm., of the ordinary prose selection 93.0 mm.

The conspicuous feature of Table XXXIII is the marked superiority in the speed with which the ordinary prose selection was read. The greatest differences are found between the isolated numerals and the prose selection. All of the subjects exhibit these differences, both in respect to average number of digits or letters read per pause and in respect to average duration of pauses as well. The differences indicating greater speed with the prose are in large proportion. Such differences in speed undoubtedly reflect the great and obvious differences between materials for prose and for isolated numerals in respect to mechanical form, context, and the attitudes which they inspire in the minds of readers. Evidently isolated numerals are much more difficult as reading-material than ordinary expository prose.

The differences in rates between the five problems and the ordinary prose materials are decidedly significant although not as great in proportion as those found in the comparison just drawn. Four of the five subjects read the ordinary prose at higher rates than they had used with the five problems. The higher speeds with the prose are due for the most part to fewer pauses per line, although the durations of the pauses on the prose are somewhat shorter than those on the problems. The obvious interpretation of the differences is found in the greater difficulty of the problems as reading-materials. To a large extent, as has been shown in previous sections of this report, the greater difficulty is due to the exactions of the numerals in the problems. It is probable also that greater exertions were undergone by the subjects in their efforts to grasp accurately the terms of arithmetical problems than to learn the facts contained in a selection of ordinary, expository prose.

3. SUMMARY

The following conclusions may be drawn from the discussion of this chapter: (1) The subjects of the present investigation read at decidedly higher rates than the subjects of Schmidt's investigation. They are, therefore, classified as decidedly better than average adults in respect to speed of reading. (2) The ordinary, expository prose material was read at significantly higher rates than either the arithmetical problems or the isolated numerals materials. The conclusion was drawn, therefore, that arithmetical problems and isolated numerals are decidedly more difficult as types of reading-materials than ordinary expository prose.

CHAPTER XI

PRACTICAL APPLICATION TO CLASSROOM TEACHING

I. THE QUESTION OF READING IN ARITHMETIC

Arithmetic is commonly reputed to be one of the most difficult subjects in the curriculum of the elementary school. The meagerness of the results which are obtained at the cost of such large amounts of time as are devoted to the study of the subject is a matter of continuous complaint. The changes which have come about as a consequence of efforts to improve the situation have resulted for the most part in a new selection of subject-matter for textbooks and in rearrangements of the sequence of topics. The problem exercises have become more practical in character and there is evidence of a tendency to employ in problems only such classes and magnitudes of numerals as are used in everyday affairs.

When the work which has been done in these directions is duly recognized, the significant fact remains that some of the most important divisions of the field have not yet been occupied. The number of scientific studies in the psychology of arithmetic is still surprisingly small. As compared with reading, arithmetic has been seriously neglected. Fortunately, however, much of the information which has been made available in reports on reading can be used in the study of arithmetic. A number of recent reports of experiments in the teaching of reading has served to emphasize the existence of numerous distinct types of reading materials each of which calls for the development of an appropriate type of reading ability on the part of the student. Arithmetical problems and isolated numerals as well, when considered as reading situations, represent distinct types of reading materials. The special types of procedure which adult subjects used in reading such materials have been described in previous chapters of this report.

Whatever the nature of the materials, however, reading is essentially the process of getting meaning from the printed page. When the subject-matter is difficult, patient and systematic search for the thought is necessary. Instead of taking pains in this fashion, children frequently resort to mechanical pronunciation of the words or mere scanning of the lines.[1] In such cases no adequate idea of the meaning is obtained, and if the materials read be arithmetical problems, a correct solution is impossible. It is scarcely an exaggeration to say that few children, including those with the experience of the upper grades, have developed a method of reading problems which could be described as a rapid and skilful attack on the reading situation.

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[1] Estaline Wilson, "Improving the Ability to Read Arithmetic Problems," *Elementary School Journal*, Vol. XXII, No. 5 (January, 1922), pp. 380–86.

The extent to which the appearance of numerals along with words in the text of a problem is responsible for this condition is but slightly understood. Numerals as a distinct and significant object of study have received very little attention in the literature of arithmetic. Occasional reference is made to the abstract character of the numerical concept and the difficulty of teaching children the meaning of the symbols. Discussions of classroom experience also are reported occasionally. Of these the question: What magnitudes of numerals should be used when new problems are introduced? is fairly illustrative. Numerals in the context of problems, but for exceptions of this character, have been almost completely neglected.

2. PRELIMINARY ANALYTICAL READING OF PROBLEMS

The presence of numerals among words, however, is only one of the features which distinguish arithmetical problems as a specialized type of reading materials. The existence of other equally complicating features is implied when teachers express the opinion that it is more difficult to teach the interpretation of problems than the mechanical skills of computation. Despite general acceptance of this opinion, scientific studies in the psychology of arithmetic have been concerned almost entirely with the field of operations. As a consequence, exact knowledge of the nature of the processes of interpretation is lacking for the most part.

Efforts have been made, notwithstanding, upon the basis of common observation to describe the reading situation which a problem offers and the preliminary thinking about it which is necessary before the reader is prepared for the work of computation. The most essential characteristic of a problem is the fact that it presents a series of conditions which describe a certain state of affairs. Some of the conditions appear in precise quantity. The quantities stand in definite relationships with each other and are stated in abstract terms.

Each of the elements of this complex situation must be comprehended by the student during the preliminary reading. He must draw in his imagination an accurate picture of the situation, which is described, and take account of each of the facts of relation. Following this, comes a canvass of the plans for solving which suggest themselves, and the passing of judgment on the appropriateness of each plan to the conditions of the problem. The reading processes which are carried on in this manner are analytical in character and call for a high degree of skill and patience, as well as for a certain amount of practical acquaintance with the facts described. It is doubtful if teachers generally have acquired anything like an adequate appreciation of the confusion which children feel when confronted with a situation to be studied in this fashion.

With the intention of facilitating the formation of working habits which will bring relief to this confusion, authors of teaching manuals undertake to outline the steps which should be followed in reading and solving a problem. The first two or three steps usually provide for the preliminary analytical reading. The following directions, which appear in a recent manual as the first three of five steps, will serve as an illustration: "*First*, the pupil must read the problem and understand what it means. *Second*, he must state in his own words what the problem calls for. . . . . *Third*, he must find the material that the problem gives to work with."[1]

The reader of this report will notice immediately that no suggestions are given concerning the proper treatment of numerals. As far as the first three steps are concerned it would seem that the directions were designed for use in connection with that special type of problem only in which numerals are not included. The author appears to assume that children are able to make as rapid and prompt a disposition of the numerals as the adult subjects of the present investigation. It is clear that a rapid and thoughtful reading of problems containing numerals is not practicable under the directions as given above, unless the reader is relieved of the details of the numerals and is free to devote his entire attention to the conditions of the problem. This desirable result, as has been shown in a previous chapter of this report, can be obtained by employing the partial method of reading numerals.

3. APPLICATION OF PARTIAL READING

The importance of conducting the difficult processes of analytical reading in the most direct and unhampered manner is great enough to warrant the inclusion with the directions quoted above of any additional directions that may be necessary. Undoubtedly supplementary directions which prescribed partial reading of the numerals would greatly facilitate the preliminary reading of problems. Such a prescription would also serve to emphasize the significance of partial reading, and the extensive possibilities of improvement which lie in its use could begin to be realized. At this point, the reader should be reminded of the fact that the problems which were employed in the present investigation were both brief and simple. Since the partial method facilitated the reading of such problems, its value for the larger and more involved problems which are found in the ordinary textbook would be correspondingly greater. And likewise, a relief measure which was desirable for adult graduate students should prove all the more helpful to children in the elementary school.

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[1] Kendall and Mirick, *How to Teach the Fundamental Subjects*, p. 169. Boston: Houghton Mifflin Co.

An effort has been made, therefore, to prepare recommendations concerning the reading of problems which should be considered as additional to the directions that are quoted above. The recommendations are as follows:

1. Pupils should be taught to distinguish between the first reading and the re-reading phases in their attack on problems.
2. They should learn to consider numerals and the accompanying descriptive conditions as different elements of a problem and separable for reading purposes.
3. During the first reading, they should devote their entire attention to the conditions of the problem.
4. At the same time skill should be developed in partial reading of numerals.
5. While this skill is being acquired, pupils should be apprised of the essential similarity between the conditions of the problem and such details of the numerals as are perceived by partial reading.

Although the preceding recommendations were derived for the most part from the findings of this report, their validity does not rest on this basis alone. They derive additional support by comparison with the findings of other investigations in the field of reading. Gray, in summarizing the principles of method which were deduced from recent studies of reading, states that emphasis of the elements on which meaning depends, improves comprehension.[1] A closely related principle is stated by Freeman: "Rate of reading is increased by attending to the meaning as distinguished from the mechanics."[2] In the case of arithmetical problems, the elements referred to by Gray, obviously, are the conditions of the problem and such details of the numerals as identity of the first digit and the number of digits. Attention to these items and to these alone is obtained by the use of partial reading as recommended above. The remaining details of the numerals are of the nature of "mechanics," as described by Freeman, and when the partial method of reading is used, the attention of the student is relieved of the "mechanics" and is free to search out the meaning.

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[1] W. S. Gray, "Principles of Method in Teaching Reading, as Derived from Scientific Investigation," *Eighteenth Yearbook of the National Society for the Study of Education*, Part II, p. 42.

[2] F. N. Freeman, *The Psychology of the Common Branches*, p. 93. Houghton Mifflin Co.

Further comparisons with the results of other investigations emphasize the fact that the use of partial reading as recommended above represents a more progressive type of reading. Progress in reading, according to Freeman, consists in a decrease of the number of pauses of the eye and an increase in the scope of recognition at each pause.[1] Gray concludes that "regular rhythmical movements of the eyes are prerequisite to rapid silent reading."[2] When partial reading is used, the numerals of a problem are not read in detail and it has been shown that fewer pauses are required to get the meaning from the printed line. As a consequence, the average amount of material perceived at a pause is increased. It is clear, therefore, that both of the conditions which Freeman describes as representative of progress in reading are encouraged by the method of partial reading. At the same time, by employment of this method, the eye is relieved of the most severe exactions of the numerals and does not suffer the delay in movement which, owing to the nature of numerals as reading materials, is unavoidable when the numerals are read in detail. By virtue of this relief, the eye is able to approximate more nearly the rhythm of movement which is customary for lines of words, and which is "prerequisite to rapid silent reading."

4. APPLICATION OF RE-READING

The recommendations which appear above are concerned exclusively with the first reading of the problem. When the first reading is completed ordinarily the pupil is ready for the re-reading. It is possible, as was shown in chapter viii, to omit the work of re-reading by employing the method of mental computation while reading the problem as printed. The latter is a more economical procedure than the alternative method of computation from copied figures. So rapid a procedure as direct computation, however, is practicable only with easy problems and for pupils of unusual arithmetical ability. Probably the great majority of pupils solve the largest proportion of their problems with the aid of pencil and paper.

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[1] F. N. Freeman, *op. cit.*, p. 83.

[2] W. S. Gray, *op. cit.*, p. 39.

For all such pupils the work of re-reading and copying the numerals is an essential step in the process of solving. Extensive use of a method, however, does not guarantee successful accomplishment. By experience, and by careful investigation as well, teachers have learned that pupils do not copy numerals accurately. The situation, as it exists, is too serious to be neglected. Intelligent and vigorous efforts should be made to eliminate errors of this kind completely. Substantial improvement undoubtedly could be effected, by relieving the pupil's mind of every avoidable distraction during the copying. Setting apart a definite place for the step of copying, in the total procedure of solving, would constitute an important move in this direction. For this reason, the teacher's plan of instruction for arithmetical problems should include a special period of drill in re-reading and copying numerals.

When the plan of instruction has been amended, in accordance with this suggestion, it is important that the most efficient methods of reading the numerals be selected for use during the drill period. The methods of re-reading which were employed by the adult subjects of the present investigation are suggestive of the type of drill which should be given. For this reason the conclusions which were derived in chapter v were taken as the basis of recommendations concerning re-reading which are submitted as follows: (1) the numerals of any digit length should be read according to their dominant main-group pattern; and (2) the simplest possible numerical language should be used.

The effect of these recommendations and the advantages that lie in their adoption may be illustrated with the numerals 56,283 and 497. When the numeral 56,283 is treated as directed, it is read as follows: five six, two eight three. In this way the main-group pattern for five-digit numerals, which calls for two groups of two and three digits respectively, is followed. No words are used except such as are required to name the digits in order of succession. In the case of the numeral 497 the proper pronunciation is four, nine seven. In this instance the dominant main-group pattern for three-digit numerals is followed and no superfluous language is included.

In the reading of both numerals, advantage is taken of the strong natural tendency of the mind to arrange the members of a series of stimuli in groups. With the verbal description as brief as possible, no unnecessary waste of energy is incurred in pronunciation. In addition to the value of economy, an important reduction is effected in opportunity for errors by reading the numerals exactly as they are printed and precisely in the form in which they are to be copied. The feasibility of the recommendations is beyond doubt since they are observed regularly in practice by various vocational groups, such as telephone operators and bookkeepers, who use numerals extensively in their daily work.

Nor are the directions as given applicable only to oral reading. It is a matter of common knowledge among students of reading that a very close connection exists between the inner speech of silent reading and the behavior of oral reading. Numerous elements of procedure are common to both. So far as the foregoing recommendations are concerned, there appears no necessity for drawing a distinction between oral and silent reading.

5. MISCELLANEOUS APPLICATIONS

Although the findings of the present investigation are not concerned extensively with the processes of computation, important data were presented in chapter viii concerning "computation direct from the problem card." The records show that this method is a very direct road to the answer and its use undoubtedly reduces the number of opportunities for error. The great rapidity with which the abler students can solve suitable problems in this manner would tend to increase the pupils' interest and concentration. For these reasons it is recommended that with abler students the process of direct computation be more extensively employed in rapid drill with problems.

The question will be raised as to the grade at which the methods of partial reading and re-reading should be introduced. The findings of the present investigation do not bear directly on this question. Nor can other than provisional conclusions be drawn until the reading of problems by children in the various grades has been studied. Significant inferences, however, can be drawn in the light of certain principles of method in teaching reading which were derived from scientific study and which are now generally accepted.

Partial reading and re-reading are methods of skilful and rapid silent reading. They represent a degree of achievement which is more advanced than mere ability to recognize the words. It is reasonably certain, therefore, that children are not prepared to read in this fashion before the teaching emphasis has been shifted from oral to silent reading, which, as is now generally known, should be done between the second and fourth grades. Beginning with the latter grade, progress in reading consists in large part in ability to master increasingly difficult materials. Arithmetical problems with several conditions and with longer numerals constitute such materials and it is this type of problem which is attacked to advantage by the use of partial reading. In the nature of the case, partial reading and re-reading are highly specialized types of procedure. It is during the fourth, fifth, and sixth grades that pupils should be trained to use different types of reading ability. In view of this consideration, and of such others as are named above, it appears that the fourth grade is the appropriate time for the introduction of the new methods.

The discussion of applications ought not to be concluded without pointing out the fact that a body of experimental data in many instances is valuable for other purposes than those which were originally responsible for the investigation. Diagnosis of individual difficulties is an increasingly important feature of instruction in modern school systems. For such work, well-trained teachers and supervisors rely to as great an extent as is possible upon the materials which are available in scientific reports. No other body of material affords an equally detailed and illuminating description of the intellectual processes which are carried on in the ordinary work of the school. The description of first reading and re-reading and of certain computational processes, which is available in the present report, will prove useful for diagnosis of difficulties with arithmetical problems. Significant but less detailed descriptions of the range of correct recall of numerals, the grouping of digits, numerical-language patterns, effect of punctuation, and of such other items as a perusal of the table of contents will disclose, are also available for the same purpose.

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By

GEORGE SYLVESTER COUNTS

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PART I. INTRODUCTION

CHAPTER I

THE PROBLEM

For two generations the public high school in the United States has grown at such a rapid rate as to give it a unique place in the history of educational institutions. Appearing late in the first quarter of the nineteenth century, it at once entered into a struggle for survival with the dominant secondary school of the time, the private academy. For a half-century the high school maintained itself with more or less success, and was well established by 1870. During the fifty years that have elapsed in the meantime it has expanded in a manner quite without precedent. From 1890 to 1918 the number of high schools reporting to the Bureau at Washington increased from 2,526 to 13,951; the number of pupils in attendance from 202,963 to 1,645,171; and the number of teachers from 9,120 to 81,034. At the same time the population of the United States increased from 62,622,250 to approximately 105,253,000. Thus while the high-school enrolment increased 711 per cent the total population increased but 68 per cent. From year to year this institution has constantly attracted a larger and larger proportion of the children of high-school age in the nation.

This remarkable expansion of the high school is impressively pictured in Figure I in which the high-school enrolment is compared with that of the elementary school and with the total population at five-year periods from 1870 to 1918. The curve for the high school begins with 1871 instead of the year before, because data for 1870 are not available. That the curves for the three series may be easily compared they are based on index numbers, derived as indicated in the explanation of the diagram. It is seen at once that the high-school curve is distinctly different from the curves for the elementary school and the total population. The latter are almost identical and show a steady progression of the arithmetical type. The increase of the elementary-school enrolment for fifty years has evidently been a function of the general population increase. The curve for the high school, on the other hand, is of the geometrical order. For the first decade, from 1870 to 1880, the increase in high-school enrolment actually failed to keep pace with the growth of population; during the following decade the two series were parallel; and since 1890 the high-school enrolment has been growing at a rate constantly accelerated from period to period without showing any marked dependence on the general increase of population. Truly the American public high school occupies a unique place among educational institutions.

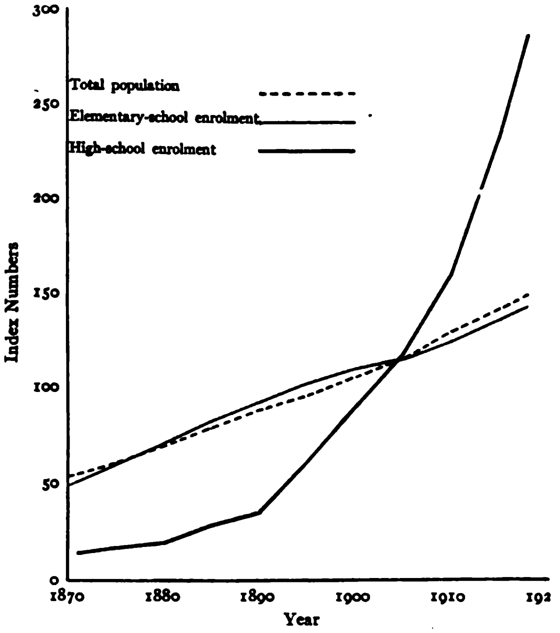

FIG. 1.—Showing relative rates of increase in the total population, the number of pupils enrolled in the elementary school, and the number of students enrolled in the public high school, United States, 1870–1918. The index numbers are found by dividing the total population and the total enrolment for each date by the respective averages for the eleven periods considered. (Adapted from *U.S. Bureau of Education Bulletin, No. 19*, 1920, p. 47.)

And the end is not yet, as the merest glance at the high-school curve shows. In view of the direction it is taking today, apparently there is but one ultimate limitation to the increase in the high-school registration, and that is to be found in the number of children of high-school age in the population. We are already hearing murmurings about universal secondary education. It is pointed out that, in spite of the very rapid increase in high-school enrolment in recent years, there are enrolled today in our secondary schools, both public and private, only about

2,000,000 out of a total of approximately 8,300,000 children of high-school age in the nation. Some of our states are passing compulsory education laws that break with our tradition of compulsory education for the elementary period only, and point toward some measure of compulsory secondary education.

The conception of secondary education as education for the selected few, whether by birth or by talent, appears to be giving ground before the assaults of political democracy and the demands of a society of increasing complexity and wealth. Some are saying that, as public elementary education is no longer education for the masses, but rather education for childhood, so secondary education is no longer education for the classes, but rather education for adolescence. Thus in a statement made by the teachers of the Washington Irving High School for Girls in New York City in 1911 we find these words: "A public high school differs from an elementary school chiefly in the age of its children." Such a statement marks a new era in the history of secondary education.

In view of the remarkable increase in high-school enrolment and the changing conception of secondary education, it is becoming increasingly pertinent to inquire into the character of that student population which is attracted to the public high school. And it is the object of the present study to make such an inquiry, at least in so far as the city high school is concerned.

Is it true in practice that the public high school differs from the elementary school chiefly in the age of its children? Has the revolutionary increase in the high-school enrolment involved the abandonment of the selective principle in secondary education? And more specifically, from what occupational groups do the high-school students come? Are all social classes fairly well represented? Is the public high school popular in the real sense of the word, or are we maintaining at public expense a secondary institution for certain favored classes in spite of this extraordinary growth of recent decades? Are the children of immigrants, the very children whose years in high school might be expected to yield the largest returns to both the individual and society, to be found in the high school in proportionate numbers? Do the various immigrant groups exhibit special or characteristic traits toward high-school attendance? What is the reaction of the negro toward the public high school? How are the children from the different social, cultural, and racial elements grouping themselves in the high school with respect to the courses pursued? What are their expectations following graduation? From the standpoint of securing a secondary education is it fortunate or unfortunate to be the last-born? How great is the misfortune of losing one or both parents? What is the psychological equipment of those children who enter high school, as compared with those who do not? Who remain for graduation? In a word, what is the sociological and psychological character of the public high school population? Many of these questions have received consideration in other investigations—they all receive some attention in the present study, although the emphasis throughout is sociological rather than psychological.

It is clear that a thorough study of the high-school population is fundamental to the solution of all problems of organization and administration. The high-school student should furnish the point of departure for the wise determination of high-school policy and practice.

It is equally clear that an adequate social interpretation of the high school must rest upon relatively complete knowledge of the social sources from which its population comes, as well as on comparatively general agreement as to the objectives at which the school is aiming. The contact which the high school makes with the social order through the Freshman year is as significant as that which it makes through the graduating class. With the former are bound up questions of large social import, such as the relation of groups to groups, the stability of classes, the source of leadership, and the distribution of power, at least in so far as these matters may be affected by the secondary school. It is hoped that this study will make some contribution toward such an interpretation.

CHAPTER II

SOURCE AND COLLECTION OF THE DATA

In attacking this problem it was decided to take a complete census of the high-school population in several American cities representing different parts of the country. Obviously, returns from a single high school drawing its students from a single quarter of one of our large cities would not be satisfactory because of the well-known tendency of populations of similar social and economic standing to gravitate to the same section of the city. It was thought desirable to study a community sufficiently complex to present all the more important groups (except the agricultural) found in modern society, and sufficiently large to provide representation of each of the groups adequate for statistical purposes. For these reasons an entire city was studied in each case.

THE GROUPS STUDIED

The cities chosen for the central part of the study were Seattle, Washington; St. Louis, Missouri; Bridgeport, Connecticut; and Mt. Vernon, New York. These four cities were selected primarily because it was found possible to secure data from them, and not because they represent an ideal combination to picture the condition of secondary education in the United States. The writer has worked in St. Louis, Seattle, and Bridgeport in one capacity or another that has brought him in touch with the public schools in these places. It was, therefore, possible to get that degree of co-operation in gathering the data that is necessary to insure reasonable accuracy in so comprehensive a study. Mt. Vernon was chosen because records from the National Intelligence Tests were already available for all students in the elementary school and the first year of the high school. Nevertheless, a fairly good case can be made out for the selection of these cities from the standpoint of their representative character, as will be pointed out in the following chapter.

In addition to the census of the high-school population, data were secured from certain other groups in Seattle, Bridgeport, and Mt. Vernon, which it was thought would throw light on our problem. In Seattle a study was made of children of high-school age at work in the commercial and industrial plants of that city. In Bridgeport facts were secured from three additional groups of children: (1) those attending the evening high school; (2) those enrolled in the state trade school, an institution offering an intensive and practical two-year course in some fifteen trades and operating under the provisions of the Smith-Hughes Act; and (3) those found in the compulsory continuation classes of the evening school, an interesting Connecticut institution enrolling children between the ages of fourteen and sixteen years who have left the regular day-school to go to work without having completed the elementary grades. In Mt. Vernon the sixth grade was included in making the study. Facts from these non-high-school groups are of exceptional value in interpreting the data from the high-school students.

Also for the purpose of getting some idea of the character of that large body of young folk attending the private secondary schools of the country, data were secured from the University of Chicago High School and the Phillips-Exeter Academy. A separate chapter will be set aside for the analysis and interpretation of data secured from these sources.

THE METHOD OF PROCEDURE

With a few exceptions a uniform procedure was followed in getting the data. In the schools, both high and otherwise, a card similar to the one reproduced below was filled out by all the children in attendance on a certain day.

MOUNT VERNON HIGH SCHOOL

Date..
Name.. Sex............ Age ....yrs......mos.
Grade in high school...................................... Course.............................
Is there a telephone in your home or the home in which you live? ....
Language or languages spoken in your home ....
Information about father: Living?........ Country of birth...................................
Present occupation.............................. Where or for whom does he work?..........
.... Is he either owner or part owner of the business in which he works?................
Occupation while alive or while working if not living or working now?.........................
Information about mother: Living?.......... Country of birth................................
Helping to support family?............ If so, how?...
If you have a guardian, give his occupation...
How many brothers and sisters have you?................ How many are older than you?..........
Do you expect to complete your high school course?...
If not, why not?.. What do you intend to do after graduation from high school?...

To each teacher in charge of a "home room" was sent the number of cards required. Along with this set of cards went a single card filled out for a hypothetical case, and the following set of instructions:

The chief object of this investigation is to discover the extent to which the students in the public high school are drawn from the different population groups. The items relating to the parents are, therefore, to be regarded as the most significant. The others are of subordinate interest.

The high-school student should fill in every blank (provided, of course, the question is pertinent to his case) except the one for his name. It is not necessary to have the student's name, if care is taken to fill out the card accurately and fully. This item would be of value only in case it should be found desirable to refer the card to the student for more complete and definite information.

In answering the questions relating to the occupation of the father, it is particularly important that the answer be as definite as possible, in order that the father may at least be accurately placed in one of the larger occupational divisions, such as, unskilled labor, semi-skilled labor, skilled labor, the clerical occupations, personal service, the professions, the managerial and employing occupations. There are two types of answers to be avoided. There is the vague and indefinite answer such as "shipyards." Unless this is accompanied by a statement of what the father does in the shipyards, the answer is without value. In the second place, the student may use a term which has several meanings, such as "agent" or "engineer." Obviously such an answer may be variously construed. There are many different kinds of agents and several different kinds of engineers. The questions concerning the father's place of work and his ownership in the business are for the purpose of ~~checking and~~ clarifying the response to the question about occupation. It may be helpful in securing accurate information to consult the following list which, according to the United States Census for 1910, includes the principal occupations of the people of the United States:

Actors
Agents, general
Agents, insurance
Agents, railway station
Agents, real estate
Architects
Authors
Baggagemen
Bakers
Barbers, Hairdressers
Bartenders
Blacksmiths
Boarding-house keepers
Boiler-makers
Bookkeepers
Brakemen
Brokers, commercial
Brokers, stock
Builders
Butchers
Cabinet-makers
Candy-makers
Canvassers
Carpenters
Carriage drivers
Chambermaids
Chauffeurs
Chemists
Cigarmakers
Clay- and stone-workers
Clergymen
Clerks, store
Clerks, other
Collectors
Cooks
Commercial travelers
Compositors
Conductors, steam railway
Conductors, street railway
Coopers
Dairy farmers
Deliverymen
Dentists
Designers
Detectives, Marshals, etc.
Domestics, general
Draftsmen
Dressmakers
Druggists
Dyers
Editors
Electricians
Electrotypers, Stereotypers
Elevator tenders
Engineers, civil
  Locomotive
  Mining
  Stationary
Engravers
Express messengers

- Farmers
- Filers, Grinders
- Firemen, fire department
  - Locomotive
  - Stationary
- Fishermen
- Foremen, manufacturing
- Foresters
- Furnacemen
- Gardeners, Florists
- Glassblowers
- Hatmakers
- Hostlers
- Hotelkeepers
- Housekeepers, Stewards
- Janitors
- Jewelers
- Laborers, domestic
  - Farm
  - Garden
  - General
  - Public Service
  - Railroad
  - Store
- Launderers (not in laundry)
- Lawyers, Judges
- Lithographers
- Longshoremen
- Lumbermen
- Machinists
- Mail carriers
- Mail clerks, railway
  - Other
- Managers, manufacturing
- Manufacturers
- Masons, brick and stone
- Merchants, retail
  - Wholesale
- Millers, grain, etc.
- Milliners
- Miners
- Molders, Founders
- Motormen
- Musicians
- Nurses, not trained
  - Others, trained
- Officials, city
  - State and U.S.
- Opticians
- Paperhangers
- Pattern-makers
- Photographers
- Physicians, Surgeons
- Plasterers
- Plumbers
- Policemen
- Porters (not store)
- Postmasters
- Pressmen, printing
- Professors, college
- Reporters
- Restaurant-keepers
- Roofers
- Sailors (U.S. Service)
  - Others
- Salesmen, and saleswomen
- Saloon-keepers
- Sawyers
- Sewers (factory)
- Shoemakers (not factory)
- Showmen
- Soldiers
- Stenographers
- Stonecutters
- Surgeons, veterinary
- Switchmen, Yardmen
- Tailors
- Teachers
- Teamsters
- Telegraph operators
- Telephone operators
- Tinsmiths
- Undertakers
- Upholsterers
- Watchmakers
- Waiters

Of course it should be made clear to the students that this information is strictly confidential and will not be used in any personal connection whatsoever. It would be well at the outset to state to them the purpose of the investigation and the necessity of having accurate information. Their co-operation is necessary in securing it.

In order to clarify any misunderstanding concerning the meanings of the questions, the card for a hypothetical case is filled out and accompanies this explanation.

Be sure to allow the students sufficient time to answer every question with care, even though it may be necessary in some cases to permit them to take the card home to consult the parents.

Each card should be examined after the student has filled it out in order to correct any obvious errors and to see that all questions are answered. Your help in this way will be greatly appreciated.

There were, however, some exceptions to the plan of procedure just outlined. The cards used in Seattle and St. Louis did not include the questions concerning the language spoken in the home and the country of the parent's birth. But they did include questions relating to student self-support which were discarded in the latter part of the investigation. Also the inquiry about the telephone in the home was made only in Bridgeport and Mt. Vernon. In Seattle and St. Louis the father's occupation three years ago was requested for the purpose of determining the extent of occupational change during high-school attendance. In one of the Seattle high schools (the first in which the study was attempted) an effort was made to get definite information as to the father's income, but without success. The question was entirely too personal and was consequently dropped from the card lest it imperil the accuracy of the returns to the other questions. Also in the first Seattle high school the questions about brothers and sisters did not appear on the card, with the result that the returns on this item are not complete for the city of Seattle. In Bridgeport and Mt. Vernon children did fill in the blank for the name, and there seemed to be no objection to it. In St. Louis and in four of the six Seattle schools this was not required of the students. In Mt. Vernon the set of instructions did not accompany the cards to the teachers. In view of the size of the school and the consequent greater intimacy of contact between the supervisory staff and the teacher, it was thought sufficient to send to each teacher merely the card filled out for a hypothetical case. In concluding this enumeration of the exceptions to the general method of procedure, it should be pointed out that the cards used in the evening high school, the trade school, and the compulsory continuation classes in Bridgeport and the Mt. Vernon sixth grade were modified in each instance to meet the requirements of the situation.

The facts for the children of high-school age at work in Seattle were obtained through personal interviews by investigators who went into all the commercial and industrial establishments of the city in which it was known that such children were at work. This was done through the co-operation of the Seattle Chamber of Commerce. For the most part the investigators were teachers in the public schools of the city.

N.B.

In Bridgeport and Mt. Vernon the sociological data were supplemented by intelligence test records. In the former city the Chapman-Welles Junior- and Senior-High School Classification Test was given to the four groups of children already mentioned. To the compulsory continuation classes and the children in the trade school, the test was given by the writer, while the giving of the tests in the day and evening high schools was under the direction of high-school supervisors and teachers who were more or less experienced in giving tests. In Mt. Vernon the National Intelligence Tests, Scale B, Form I, were given by persons within the system.

The data for the study were collected during the years 1919, 1920, and 1921. The cards were filled out in the Seattle high schools at intervals during the months of November and December of 1919, and January of 1920. The children of high-school age at work in that city were interviewed during the Christmas vacation of the school year 1919–20. The data from St. Louis were secured in December, 1920. In Bridgeport the cards for both the day and evening high schools and the continuation classes were filled out in December, 1920, and those for the trade school in February, 1921. The intelligence tests were given there in December, 1920, and in January, February, and March, 1921. In Mt. Vernon the tests were administered in October, 1920, and the cards were filled out the following May (1921).

NUMBER OF CASES STUDIED

In getting the returns from the high schools an effort was made to obtain responses from all children in attendance on that day. The number filling out the cards in each city is indicated in Table I. Thus for this basic part of the study there are 17,992 cases. Of the 8,264 cases reported for the St. Louis high schools, 727, constituting the entire enrolment of one of the schools, are negroes. This very interesting group will receive special attention in a separate chapter.

TABLE I

NUMBER AND SEX OF HIGH-SCHOOL STUDENTS FILLING OUT THE INFORMATION CARD IN EACH OF THE CITIES

City	Number of High-School Students		
	Girls	Boys	Total
Bridgeport	1,220	1,037	2,257
Mt. Vernon	516	568	1,084
St. Louis	4,462	3,802	8,264
Seattle	3,572	2,815	6,387
Total	9,770	8,222	17,992

The number of children in the special groups outside the regular day high school from whom information of a similar character was received is shown in Table II. No one of these groups is very large. Neither is any claim of complete returns made except for the trade school and the Mt. Vernon sixth grade. In the other three cases the most that can be claimed is that random samplings have been secured. The number of children of high-school age at work in Seattle was certainly much greater than 514. In the Bridgeport Evening High School there were approximately one thousand students. Many of them were far beyond the high-school age. But only students twenty-one years of age or less were included in this study. Likewise returns were secured from only about 50 per cent of the children in the compulsory continuation classes. In each instance, however, those studied are thought to be quite representative of the group.

TABLE II

NUMBER AND SEX OF CHILDREN FILLING OUT THE INFORMATION CARD IN EACH OF THE NON-HIGH-SCHOOL GROUPS

Group	Number of Children		
	Girls	Boys	Total
Children of high-school age at work in Seattle	249	265	514
Bridgeport Evening High School	147	96	243
State Trade School at Bridgeport	14	184	198
Bridgeport Compulsory Continuation Classes	305	274	579
Mt. Vernon Sixth Grade	341	398	739
Total	1,056	1,217	2,273

TABLE III

NUMBER AND DISTRIBUTION OF CHILDREN TAKING THE INTELLIGENCE TESTS

Group	Number of Children		
	Girls	Boys	Total
Bridgeport High School	1,362	1,169	2,531
Bridgeport Evening High School	86	95	181
State Trade School at Bridgeport	9	164	173
Bridgeport Compulsory Continuation Classes	220	201	421
Mt. Vernon High School	192	216	408
Total	1,869	1,845	3,714

The groups to which the intelligence tests were administered were not completely identical with those for which the sociological data were secured, because some days or weeks or even months elapsed in each case between filling out the cards and taking the test, or vice versa. The number taking the test in each group is shown in Table III. It will be noted that in some cases the number taking the test is larger than the number filling out the cards, and in other cases the reverse is true. However, this is a matter of no importance when group results alone are wanted.

ACCURACY

The accuracy of the data is of course a matter of fundamental importance. Are the returns accurate or at least of such a character as to guarantee reliable conclusions? Let us first consider the sociological data.

The first question here pertains to the character of the information requested and the wording on the card. Is the high-school student in possession of the information asked for? He undoubtedly is, with the possible exception of the information relating to the father's ownership of the business in which he works. And even here, the responses to the other questions about the father's occupation make it possible in most cases to arrive at a reasonably satisfactory single result. Are the questions definite and do they call for specific information? Here again the answer is in the affirmative. Is there good reason for suspecting that the high-school student might color his replies to some of the questions? Probably in some cases there would be a temptation to put a more favorable construction on the father's occupation than the facts would warrant. This temptation, however, was largely removed in St. Louis and in the four Seattle high schools where the student's name was not called for. Thus the returns from Bridgeport and Mt. Vernon may be checked against those from the other two cities. It is also highly probable that the average high-school student is over-optimistic about his prospects. Consequently little weight should be attached to his stated intentions following graduation from high school, as an index of what he really is going to do. But, even so, as a statement of his intention, as an idea that occurred to him for a reason, it does in the writer's opinion have some validity. And no other claim for accuracy will be made regarding it during the course of the study. Did the students make a serious effort to fill out the cards and furnish the desired information? They evidently did in the great majority of cases. It is true that in almost every high school one or two boys took the whole matter as a great joke and taxed their ingenuity to the limit to give the least possible bit of valuable information and the largest possible amount of nonsense. But, on the whole, the replies showed careful attention to the work in hand and a serious effort to co-operate in providing the information.

A second general question pertains to the collection of the data. Is there any good reason for believing that the returns are from a selected group? On the whole the answer is a negative one. In each high school, with the exception of the Soldan High School of St. Louis, the day on which the census was taken was a normal day and the cards were received from practically all the students in attendance. At the Soldan the cards were filled out the day before the Christmas vacation and there were many absent, particularly among the Seniors. Subsequently an effort was made to complete the census, but evidently there was a considerable number of students in this high school from whom no cards were received. And it happens that incompleteness at this point has probably colored the returns from St. Louis to a small degree, because the Soldan High School serves a rather homogeneous and select middle-class constituency. It should therefore be remembered, when we note the social composition of the high-school population of St. Louis, that our figures do not give the non-labor groups as large a representation as they probably have. In collecting data from the non-high-school children there is no good reason for suspecting bias. For obvious reasons, in the case of the evening high school in Bridgeport, the study was limited to students of twenty-one years of age and under. Except in those cases where it is expressly stated to the contrary, the returns apparently are complete and unselected.

CHAPTER III

CHARACTER OF THE CITIES CHOSEN FOR THE STUDY

Before going into an analysis of the results of the investigation, it will be well to examine briefly into the character of the cities from which the data were secured. This is a matter of prime importance in a study such as this one, in which the sociological interest is prominent.

It has already been intimated that the study was not undertaken in these cities primarily because of their representative character. They were studied because they presented the opportunity. They were studied because it was possible to study them. Nevertheless an examination of the facts will show them to be fairly representative of the country.

GEOGRAPHICAL AND HISTORICAL

In Seattle we have a city of the Pacific Coast, representative of the North and the far West. St. Louis lies between the North and the South, and between the East and the West, exhibiting in some measure the characteristics of all. Bridgeport, an Atlantic seaport and industrial center, and Mt. Vernon, a growing community just outside the city of New York, stand for the East. To be sure, the real South is not adequately represented; neither is the Great Lakes region; nor the plains states. Furthermore, Boston and New England might not be satisfied with Bridgeport. But it must be admitted that these four cities do represent different parts of our country.

No one of our cities can trace its history back to 1607 or 1620, although the city of Bridgeport does claim that there was a settlement of white people made in territory constituting the site of modern Bridgeport as early as 1639. It was not, however, until 1836 that the city was incorporated. St. Louis is one of the oldest cities west of the Alleghanies, reaching back to the days of Marquette and Joliet and La Salle. It was incorporated as a city in 1822, and thus holds the distinction of having been the first city incorporated west of the Mississippi. Naturally the rise of Seattle came later as a part of the development of the Oregon country. Yet its date of incorporation goes back to 1869. Mt. Vernon, though possessing a considerable history as a town, did not become a city until 1892.

An examination of Table IV is of interest at this point. It shows the increase of population in each of the four cities from 1870 to 1920. The facts here presented reveal important and significant differences among the cities. Clearly they are not all of the same type. Fifty years ago St. Louis was a great urban center of more than 300,000 inhabitants. Seattle, on the other hand, a city that likes to call itself the New York of the Pacific today, was at that time nothing but an assemblage of shacks about a trading post, housing scarcely more than a thousand souls. St. Louis has been growing gradually during this period, but not so rapidly as most American cities, while the growth of Seattle, especially during the decade from 1900 to 1910, has been nothing short of phenomenal. In Bridgeport and Mt. Vernon we have two cities exhibiting the steady and rapid growth characteristic of industrial centers developing in the well-populated sections of our country during the last half-century. They are intermediate between Seattle and St. Louis.

TABLE IV

Increase of Population in Each of the Four Cities from 1870 to 1920

Year	Bridgeport	Mt. Vernon	St. Louis	Seattle
1870	18,969	2,700	310,864	1,107
1880	27,643	4,586	350,518	3,533
1890	48,866	10,830	451,770	42,837
1900	70,996	21,228	575,238	80,671
1910	102,054	30,919	687,029	237,194
1920	143,555	42,726	772,897	315,312

For the purposes of this study it is fortunate that we have cities showing these different rates of growth. In Seattle we find a vigorous, adventurous, and youthful population, composed of elements lured to this metropolis of the Northwest from the states to the east, and among whom the native son is rare indeed. Here society is less stable; the lines between social classes are not rigidly drawn. Everybody works. Seattle is not a city of magnificent residences. In St. Louis, on the other hand, we have an altogether different situation. The city is old, in American and middle western terms, and the population has not increased rapidly during the last generation. Society is more stable. The lines between classes are more closely drawn, although the people are less aware of those lines in St. Louis than in Seattle. Habit and custom have assumed their expected rôle. The old families do exist and St. Louis does have its magnificent residences. It is a place in which to live as well as to work. These differences are of the largest significance for the study.

THE PEOPLE

A study of the people inhabiting these four cities shows us a population almost as varied and complex as that of the nation itself. In Table V are the facts pertaining to race and nationality as given in the latest available census, that of 1910. A glance at this table is illuminating. Bridgeport is one of the most foreign of American cities with only 26.6 per cent of its inhabitants reported as native white of native parentage. Practically the entire remainder is either foreign born or of foreign and mixed parentage, since the colored races have but a negligible representation. At the other extreme is Seattle which is one of the least foreign of our cities with 44.6 per cent of its inhabitants of native white parentage. In St. Louis is found a different situation. The native white stock is well represented, as is also the native white of foreign and mixed parentage; whereas the proportion of foreign-born white is the lowest for the four cities, and is decidedly low for the larger American cities. Mt. Vernon presents no distinctive features. Finally it should be noted that St. Louis has a good representation of negroes, while the Orientals, particularly the Chinese and the Japanese, constitute an important element in the population of Seattle.

TABLE V

RACIAL AND ETHNIC COMPOSITION OF THE POPULATIONS OF THE FOUR CITIES ACCORDING TO THE CENSUS OF 1910

RACE OR NATIONALITY	BRIDGEPORT		MT. VERNON		ST. LOUIS		SEATTLE	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Native white (native parentage)	27,156	26.6	11,433	37.0	269,836	39.2	105,784	44.6
Native white (foreign and mixed parentage)	37,314	36.6	10,539	34.0	246,946	35.9	61,134	25.8
Foreign-born white	36,180	35.5	8,029	26.0	125,706	18.4	60,835	25.6
Negro	1,332	1.2	896	2.9	43,960	6.4	2,296	1.0
Indians, Chinese, Japanese, etc.	72	.1	22	.1	581	.1	7,145	3.0
Total	102,054	100.0	30,919	100.0	687,029	100.0	237,194	100.0

But how are the different immigrant strains represented? Do we find both the "old" and the "new" immigration? In Table VI is the answer. Here the immigrants and native whites of foreign parentage are grouped according to the country from which they or both their parents have come. Again each of the cities presents individual features. In Bridgeport the most numerous immigrant group comes from that polyglot section of Europe formerly known as the Austro-Hungarian Empire; in Mt. Vernon the Italians hold first place; in St. Louis almost one-half of the immigrants are of German stock; while in Seattle the immigrants from the Scandinavian countries constitute the largest single group, as classified. In so far as the immigrant population is concerned, Seattle represents the "old" immigration, the immigration from the north and west of Europe, with only 10.8 per cent from Austria-Hungary, Italy, and Russia. In St. Louis, which is also predominantly a center for the "old" immigration, 22 per cent of its immigrants are from these three countries of the south and east of Europe. In Mt. Vernon this percentage rises to 37.1; and in Bridgeport to 46.7. Thus it is clear that from the standpoint of race and nationality these four cities give a fairly complete picture of urban America.

TABLE VI

NATIVITY OF FOREIGN-BORN WHITES AND PARENTS OF NATIVE WHITES OF FOREIGN PARENTAGE IN THE FOUR CITIES (1910)

COUNTRY	BRIDGEPORT		MT. VERNON		ST. LOUIS		SEATTLE	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Austria-Hungary	16,883	25.8	426	2.8	28,377	9.8	2,901	2.9
Canada	2,002	3.1	345	2.2	3,138	1.1	14,317	14.3
Great Britain	6,383	9.8	1,367	8.9	11,270	3.9	13,025	13.0
Germany	6,136	9.4	3,924	25.5	138,094	47.9	13,898	13.9
Ireland	13,070	20.0	2,403	15.6	41,326	14.3	7,294	7.3
Italy	7,420	11.3	4,371	28.3	11,360	3.9	4,399	4.4
Russia	6,242	9.6	933	6.0	23,868	8.3	3,513	3.5
Scandinavia	3,725	5.7	537	3.5	2,926	1.0	28,353	28.5
All others	3,437	5.3	1,112	7.2	28,350	9.8	12,209	12.2
Total	65,298	100.0	15,418	100.0	288,709	100.0	99,909	100.0

OCCUPATIONS

For the purposes of this study perhaps the most important information about the population pertains to the occupations. In what occupations are the people of these four cities engaged? The facts on this point, according to the census of 1910, are found in Table VII. An examination of this table shows the variety of occupational interest characteristic of American cities. Of the nine great occupational divisions recognized by the census the seven which might be expected in urban communities are proportionately represented in these four cities. To be sure, the percentage of persons engaged in public service, according to the census classification, is quite small in each case, but this is characteristic of cities generally. Although American cities are as a rule predominantly industrial, and although the cities here studied are no exceptions to this rule, yet the table shows marked differences among them in the proportion of the inhabitants engaged in the manufacturing and mechanical occupations. At the one extreme is Bridgeport with over 60 per cent of its people so engaged, and at the other is Seattle with scarcely more than 30 per cent. St. Louis occupies a middle ground.

TABLE VII

TOTAL NUMBER OF PERSONS TEN YEARS OF AGE OR OVER ENGAGED IN EACH SPECIFIED OCCUPATION IN EACH OF THE FOUR CITIES (1910)

OCCUPATIONAL DIVISION	BRIDGEPORT		MT. VERNON		ST. LOUIS		SEATTLE	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Agriculture, forestry, and animal husbandry......	477	1.0	120	1.0	2,203	.7	4,460	3.6
Extracting of minerals....	26	.1	20	.2	1,621	.5	1,915	1.6
Manufacturing and mechanical industry......	30,696	61.4	4,147	33.6	133,151	41.5	39,639	32.4
Transportation..........	2,788	5.6	939	7.6	28,079	8.7	17,116	14.0
Trade..................	5,053	10.1	2,330	18.9	54,117	16.9	20,266	16.6
Public service..........	681	1.4	169	1.3	5,858	1.8	2,585	2.1
Professional service......	2,259	4.5	1,173	9.5	15,952	5.0	8,762	7.2
Domestic and personal service...............	4,531	9.1	2,107	17.0	46,288	14.5	17,289	14.1
Clerical occupations.....	3,407	6.8	1,347	10.9	33,445	10.4	10,253	8.4
Total.............	49,918	100.0	12,352	100.0	320,714	100.0	122,285	100.0

The range here presented is almost as great as that to be found among the larger American cities. Bridgeport is an industrial center of the clearest type, while Seattle is a community with a greater variety of interests, in which industrial development is in its earlier stages. In the latter city there are almost as many persons engaged in trade and transportation as in industry. This is to be expected in a great seaport in which the commercial interest is naturally very large. The table shows important differences in the proportion of the populations engaged in the other occupations, but enough has been said to make it clear that these four cities are fairly representative of American cities with respect to occupational interests.

A slight additional comment of a more specific nature concerning the character of the industrial undertakings in each of the four cities will be of value, because of the dominant rôle played by industry in the American city. To an appreciable degree industry gives the city its tone.

Almost every conceivable thing is manufactured in Bridgeport from collar buttons to field artillery. Its most important products are corsets; foundry and machine-shop products; electrical machinery and supplies of all sorts; cutlery and tools; and copper, tin, and sheet-iron products. In addition, the people of Bridgeport make automobiles, carriages, cigars, bicycles, boots and shoes, carpets, firearms, paint, patent medicines, hosiery, sewing machines, silverware, typewriters, and a host of other things. Mt. Vernon is largely a place of residence for persons working in New York City. Yet there are several concerns engaged in the manufacture of motor vehicles, optical instruments, silver products, shirt waists, etc. St. Louis manufactures a great variety of goods. The products in whose manufacture the largest numbers of workers are engaged are boots and shoes; printing and publishing; men's and women's clothing; foundry and machine-shop products; furniture; lumber and timber products; carriages and wagons; pottery and terra cotta; stoves and furnaces; copper, tin, and sheet-iron products; and in a happier day great quantities of liquors and stimulating beverages. Seattle, though less given to manufacture, does produce many things. Quite naturally first among them are lumber and timber products. Others are foundry and machine-shop products; confectionery; copper, tin, and sheet-iron products; flour and grist-mill products; and furniture. There are also a goodly number of persons engaged in printing and publishing; the slaughtering and meat-packing industries are developing; and during the war Seattle developed into a great shipbuilding center.

VALUE OF PROPERTY

No picture of a city is complete without some reference to the value of its property. This is especially true in any study of public education, an enterprise dependent on taxation for support.

According to a special report of the census in 1919 the estimated true value of property per capita in St. Louis was $1,497.85, while the average for the group of American cities having over 500,000 inhabitants, the group to which St. Louis belongs, was $1,584.51. The corresponding figures for Seattle were $1,630.88 and $1,617.88; for Bridgeport, $1,592.05 and $1,353.25; and for Mt. Vernon, $1,286.28 and $1,234.30. According to these estimates, no one of the four cities represents either of the extremes of wealth or of poverty. With the exception of St. Louis, they are slightly above the average for cities of their class, but the superiority is not marked in any case. All appear to be cities of moderate wealth.

THE HIGH SCHOOL AND CHILDREN OF HIGH-SCHOOL AGE

A final question and one most significant for this study pertains to the high school itself in these four cities. What proportion of the children of high-school age (taken somewhat arbitrarily in this study to include all children from fourteen to seventeen years of age) are enrolled in the high school? The facts bearing on this point appear in Table VIII in which is given the estimated number of children of high-school age in each of the cities and in the nation in 1918, the number of children enrolled in the public high schools according to the report of the Bureau of Education for the school year 1917–18, and the percentage that the latter is of the former. No claim is made of absolute accuracy for these figures, but they are unquestionably approximately correct.

TABLE VIII

NUMBER OF CHILDREN OF HIGH-SCHOOL AGE, NUMBER OF CHILDREN IN THE PUBLIC HIGH SCHOOLS, AND PERCENTAGE OF CHILDREN OF HIGH-SCHOOL AGE IN THE PUBLIC HIGH SCHOOLS IN EACH OF THE FOUR CITIES AND IN THE UNITED STATES IN 1918

	Bridgeport	Mt. Vernon	St. Louis	Seattle	United States
Children of high-school age.	10,618	3,169	59,324	23,368	8,053,872
Children in public high schools.	1,990	1,010	10,586	6,719	1,645,171
Percentage of children in public high schools.	18.7	31.9	17.8	28.8	20.4

The table shows that two of the cities (Bridgeport and St. Louis) have a somewhat smaller proportion of their children of high-school age in the public high school than the country as a whole; whereas, the other two (Mt. Vernon and Seattle) are markedly above the average practice for the nation. Seattle's record is particularly noteworthy in a city of more than 300,000 inhabitants. In fact there are few cities as large as Seattle having so large a proportion of their children of high-school age in high school. This diversity of practice in a matter which lies at the heart of this study is of large value and reference to this table will be made in later chapters in connection with the analysis and interpretation of the results of the investigation.

PART II. ANALYSIS OF THE DATA

CHAPTER IV

PARENTAL OCCUPATION—CLASSIFICATION

Occupation is the central fact in the lives of the great masses of people. It is the interest that occupies the time and energy of the ordinary person for the major part of his waking hours. In large measure it determines his place of residence, his associates during the working-day, and his more intimate acquaintances and friends of the leisure moments. If pursued for years, it will set its mark on his physical nature and will stamp his mind with its special pattern. It will determine to a considerable degree what he does, what he thinks, and his outlook on life. Increasingly, it seems, a man's occupation in this complex world determines his political affiliations. Consequently this part of the study, setting forth the relation of parental occupation to high-school attendance, may be regarded as its most important contribution.

CLASSIFICATION OF OCCUPATION

The first task encountered as soon as the tabulation of the data commenced was a classification of occupations significant for the purposes of the study. The classification used by the census, recognizing nine great occupational divisions, was inadequate, since it fails to distinguish the various grades of occupations within an industry, due to large-scale production and specialization of function. For example, the division of "manufacturing and mechanical industries" includes in one group those who own the industries, those who manage them, those engaged as technicians, and those who perform the manual labor involving varying degrees of skill. All persons concerned with the production of a particular commodity are grouped together. For the purposes of the census this classification is undoubtedly satisfactory, but for the purposes of this study it is as clearly unsatisfactory.

The ideal classification would be Taussig's famous classification into the five non-competing groups, viz., professional, semi-professional, skilled, semi-skilled, and unskilled occupations. And at the outset of the investigation this classification was chosen, but as the work proceeded it was abandoned. The reasons for this were several. As already indicated this classification is ideal, but it was found exceedingly difficult to use. The lines between the groups are not clearly defined in industry, to say the least. The division between the skilled and the unskilled is certainly no longer altogether clear. However, with relatively complete information for each case, this classification could be attempted with some measure of success; but with the relatively meager information obtained in this study, it was found unworkable without resorting to many arbitrary decisions. It was therefore decided to abandon the attempt at the ideal and adopt a classification that would not give the impression of greater accuracy than the facts would warrant.

The classification finally adopted takes the census classification as a basis, but goes considerably further by breaking up the more complex groups and recognizing certain other groups running directly across the great occupational divisions of the census. The aim is to get classes of reasonable homogeneity from the standpoint of social status, position in the economic order, and intellectual outlook. The result is not altogether satisfactory, and it is far from the ideal, but facts to be presented later show the classification to possess some merit. The groups recognized are as follows:

I. *Proprietors.*—Bankers, brokers, druggists, hotel-owners, landlords, laundry-owners, lumbermen, manufacturers, merchants, mine-owners, publishers, shopkeepers, undertakers, etc.

II. *Professional service.*—Actors, architects, artists, authors, cartoonists, clergymen, dentists, engineers (civil, chemical, electrical, mechanical, mining), journalists, lawyers, librarians, musicians, pharmacists, photographers, physical directors, physicians, social workers, surgeons, teachers, etc.

III. *Managerial service.*—Agents (express, railroad, steamship, telegraph), contractors, foremen, managers, officials and inspectors (private), officials and inspectors (public), superintendents, etc.

IV. *Commercial service.*—Agents (real estate and insurance), buyers, clerks in stores, commercial travelers, salesmen, etc.

V. *Clerical service.*—Accountants, bookkeepers, canvassers, cashiers, clerks (except in stores), collectors, etc.

VI. *Agricultural service.*—Dairymen, farmers, fruit-growers, gardeners, nurserymen, ranchmen, stock-raisers, etc.

VII. *Artisan-proprietors.*—All artisans who own the shops in which they work, including bakers, barbers, blacksmiths, cabinet-makers, cleaners and dyers, cobblers, draftsmen, electricians, machinists, milliners, plumbers, printers, tailors, tinners, etc.

VIII. *Building and related trades.*—Cabinet-makers, carpenters, electricians, glaziers, lathers, masons, plasterers, plumbers, sheet-metal workers, structural iron workers, etc.

IX. *Machine and related trades.*—Anglesmiths, blacksmiths, coppersmiths, designers, draftsmen, engineers (stationary), firemen (except locomotive and fire department), forgemen, founders, machinists, mechanics, millwrights, molders, pattern-makers, tinsmiths, toolmakers, etc.

X. *Printing trades.*—Bookbinders, compositors, electrotypers, engravers, linotypers, pressmen, printers, typesetters, etc.

XI. *Miscellaneous trades in manufacturing and mechanical industries.*—Bakers, bottlers, brewers, cigar-makers, cobblers, coopers, corset-cutters, cutlers, dyers, glass-blowers, grinders, meat-cutters, milliners, platers, shoe-cutters, tailors, tanners, weavers, etc., and machine operatives.

XII. *Transportation service.*—Baggagemen, brakemen, chauffeurs, conductors, draymen, engineers (locomotive and marine), firemen (locomotive and marine), longshoremen, mail carriers, mariners, motormen, sailors, switchmen, yardmen, etc.

XIII. *Public service.*—Detectives, firemen (fire department), guards, marines, marshals, policemen, sailors, soldiers, watchmen, etc.

XIV. *Personal service.*—Barbers, chefs, cooks, doorkeepers, janitors, launderers, porters, sextons, waiters, etc.

XV. *Miners, lumber-workers, and fishermen.*

XVI. *Common labor.*

XVII. *Occupation unknown.*

The first group, the proprietors, includes all the owners of enterprises in whatever field, except the farmers and certain small owners put into Class VII among whom ownership is really secondary to the practice of some skilled trade. This group is the most powerful occupational group in any American community; its members constitute the backbone of the chambers of commerce and similar organizations; it occupies a strategic position in a society based on private property and it controls economic power. In criticism of this classification, it may be said that there is an exceedingly wide range among proprietors. Small shopkeepers are classed with captains of industry and owners of great wealth. There is without question some justice in this criticism, and in the early part of the investigation an effort was made to divide this group into "large" and "small" proprietors. But it was necessary to abandon this effort because of the practical impossibility of introducing this distinction with the available data. Nevertheless ownership does give a certain security even though the business is small. It also gives an outlook on life. While there is superficial heterogeneity, there is fundamental homogeneity throughout the group.

The second group, professional service, requires little comment. It is perhaps in all respects the most homogeneous group in the classification. Its membership is the most "learned" in the community.

In the third group are placed all those persons except owners, who perform any managerial or directing function in all enterprises, whether of a public or private character. In the ordinary industrial organization it includes everything from foreman up to superintendent.

All persons who are active in the buying or selling of goods, except owners, are placed in the fourth group, commercial service. Real estate and insurance agents are all included in this class, even though they are said to be owners or part owners of the business, because in most cases ownership may mean nothing more than the renting of an office. The function performed is that of salesman.

The fifth and sixth divisions require no explanation. Clerical service is rather clearly defined. Agricultural service includes owners, tenants, and laborers. It is, however, a small group in any city and is foreign to the urban economy.

The seventh division, labeled the artisan-proprietors, covers a group of occupations which are really reminiscent of an earlier economic order. Toward the beginning of this study these occupations were not recognized as a separate group, but, as case after case appeared in which the artisan owned his shop, it became clear that some separate provision should be made for them.

The eighth, ninth, tenth, and eleventh divisions include all skilled and semi-skilled workers in the manufacturing and mechanical industries. The first three are among the most homogeneous groups in the entire classification, each being composed of a series of rather closely related and well-known trades. The fourth is a sort of an omnibus class into which all the remaining occupations in this rather broad field, including the machine operatives, are placed. It partakes more of the nature of the semi-skilled trades than any other group in the classification.

The twelfth division includes practically all of the workers in the field of transportation and is consequently a rather heterogeneous class. The group ranges from longshoremen to railroad engineers and conductors. But since the group is not large in any city it was thought unwise to further complicate the classification through the recognition of another division.

The last five divisions require little comment. The meaning of public service is clear and the same may be said of personal service. The fifteenth division is quite heterogeneous, including the workers in mining, lumbering, and fishing, but it hardly exists in our cities. In the sixteenth division are placed all common laborers from whatever field. It includes all apprentices and helpers, and is as nearly unskilled as any group to be found in modern society. And finally, in the seventeenth and last division, are found all cases in which the father's occupation was not given or in which the data were so meager or indefinite as to make classification impossible.

The data analyzed and interpreted in the following chapters are based on the foregoing classification. In every case where information was given the student was placed in that division to which his father's occupation belongs, even though the father was unemployed at the time, retired for any reason, or not living. In case the father's occupation was not given and the occupation of the guardian was, the classification follows the latter. In no instance was the mother's occupation used for this purpose, even though information concerning both the father and guardian was lacking. This policy is based upon the assumption that the father's occupation is of real significance in determining the social status and outlook of the child almost regardless of whether he is working at the time or not; and that the occupation of the mother is of little importance in this respect. She does what she is able to do, when it is necessary for her to support her children, and the opportunities open to her are limited.

It should be repeated that the occupational classification outlined in this chapter is not ideal in theory, and in practice is less so. In the first place it is extraordinarily difficult to classify occupations today, because the lines between them are not clearly drawn in the economic order and occupations are being formed and reformed in an evolutionary series. The profound changes ushered into industry with the advent of power-driven machinery, marked concentration of labor, and minute specialization have not run their full course. In the second place, in some cases the information given by the student was not so clear as might be desired. These difficulties and shortcomings should not be forgotten while reading the following chapters.

CHAPTER V

PARENTAL OCCUPATION AND TOTAL ENROLMENT

In this chapter will be presented the facts showing the occupations of the fathers or guardians of 17,265 students in the high schools of the four cities. This number does not include the 727 colored children in the Sumner High School in St. Louis, which will receive special treatment in a separate chapter. In interpreting these facts attention will be directed to the number of persons in the general population engaged in the different occupations.

OCCUPATIONAL COMPOSITION OF THE HIGH-SCHOOL POPULATION

The gross data are given in Table IX. All four high-school years are combined. It will be observed that of the 17,265 students, 3,427 have fathers who are occupied as proprietors, 1,629 have fathers engaged in some sort of professional service, and so on.

TABLE IX

OCCUPATIONS OF THE FATHERS OR GUARDIANS OF 17,265 STUDENTS IN THE HIGH SCHOOLS OF FOUR CITIES—ALL FOUR YEARS COMBINED—
1919–20, 1920–21

PARENTAL OCCUPATION	NUMBER					PERCENTAGE				
	Bridgeport	Mt. Vernon	St. Louis	Seattle	Total	Bridgeport	Mt. Vernon	St. Louis	Seattle	Total
Proprietors	451	304	1,603	1,069	3,427	20.0	28.0	21.3	16.7	19.8
Professional service	137	128	661	703	1,629	6.1	11.8	8.8	11.1	9.4
Managerial service	385	181	1,228	1,052	2,846	17.1	16.7	16.3	16.5	16.5
Commercial service	163	122	818	534	1,637	7.2	11.3	10.9	8.3	9.5
Clerical service	98	67	550	281	996	4.3	6.2	7.3	4.4	5.8
Agricultural service	49	11	63	293	416	2.2	1.0	.8	4.6	2.4
Artisan-proprietors	111	56	398	158	723	4.9	5.2	5.3	2.5	4.2
Building trades	116	57	428	724	1,325	5.1	5.3	5.7	11.3	7.7
Machine trades	318	25	432	452	1,227	14.1	2.3	5.7	7.1	7.1
Printing trades	7	4	110	65	186	.3	.4	1.4	1.0	1.1
Miscellaneous trades	139	32	362	121	654	6.2	3.0	4.8	1.9	3.8
Transportation service	77	26	397	346	846	3.4	2.4	5.3	5.4	4.9
Public service	57	9	111	93	270	2.5	.8	1.4	1.5	1.6
Personal service	52	6	81	99	238	2.3	.5	1.1	1.5	1.4
Miners, lumber-workers, fishermen	......	1	5	60	66	......	.1	.1	.9	.4
Common labor	38	18	69	88	213	1.7	1.6	.9	1.4	1.2
Unknown	59	37	221	249	566	2.6	3.4	2.9	3.9	3.2
Total	2,257	1,084	7,537	6,387	17.265	100.0	100.0	100.0	100.0	100.0

For comparative purposes the reader should pass to the second part of this table in which the facts are given in percentages. A glance at the percentages for the four cities combined shows four non-labor groups in the lead in the following order: first, the proprietors; second, managerial service; third, commercial service; and fourth, professional service. Among the labor groups only two could be said to be well represented, namely, the building trades and the machine trades. The printing trades, public service, personal service, miners, lumber-workers, fishermen, and common labor have a negligible representation. But 3.2 per cent of the cases are classified as unknown. This means that satisfactory information was received from practically all of the students.

An examination of the remainder of the table, giving the facts for the individual cities, shows considerable variation in the character of the high-school population from city to city. Thus the percentage of proprietors ranges from 16.7 in Seattle to 28.0 in Mt. Vernon; that of professional people from 6.1 in Bridgeport to 11.8 in Mt. Vernon; that of agricultural workers from .8 in St. Louis to 4.6 in Seattle; that of persons engaged in the building trades from 5.1 in Bridgeport to 11.3 in Seattle; that of those working in the machine trades from 2.3 in Mt. Vernon to 14.1 in Bridgeport. It is interesting, on the other hand, to note the constancy of the representation of managerial service, the percentage ranging merely from 16.3 in St. Louis to 17.1 in Bridgeport, a range of less than 1 per cent. The differences in the character of the high-school population are to be explained either in terms of the special occupational and industrial interests of the four cities or in terms of the proportion of children of high-school age enrolled in the high school. For example, the first explanation accounts for the very large proportion of students in the Bridgeport High School whose fathers are engaged in the machine trades. Because of the nature of Bridgeport's industries an exceptionally large number of her workers are machinists. Consequently the number of machinists' children in the high school is unusually large. As a matter of fact, there is evidence to indicate that the machinists of Seattle send a much larger percentage of their children to high school than do those of Bridgeport. The relatively large proportion of children in the Mt. Vernon High School coming from the non-labor groups is also to be explained in terms of the character of the adult population. As already pointed out, Mt. Vernon is largely a residential city for middle-class folk having business in New York City. Differences in occupational and industrial interests, however, do not account for the appreciably larger representation of the proprietors in the St. Louis than in the Seattle schools. The second explanation is pertinent here. In the adult population there is actually a larger proportion of proprietors in Seattle than in St. Louis. But since the St. Louis schools attract a much smaller percentage of the children of high-school age, her high-school population is more highly selected, containing fewer children from the laboring classes and a larger proportion from the well-to-do groups. Many other interesting differences will be noted by the careful reader who examines the table.

A more concrete picture of the high-school population is presented in Table X, in which are given the probable occupations of the fathers or guardians of one hundred high-school students taken at random from the high-school populations of the four cities. If all the students in these high schools should be transported to the same place, and if the reader, happening to arrive at that place, should make inquiry of the first one hundred young people encountered regarding the parental occupation, he would get a result not very different from that presented in this table. The writer is of the opinion further that a similar sampling of the high-school populations of four other representative American cities would yield a corresponding result, because of the fundamental similarity of populations and conditions from city to city. To be sure, the exact occupations here given would not all appear, although a surprisingly large number of them would, but the general impression conveyed would be about the same. Thus, instead of a hotelkeeper there might be an additional grocer; among the professional people there might be several physicians, and no civil engineer or architect; and in the place of the painter there might appear a sheet-metal worker. In constructing this table individual occupations were necessarily selected somewhat arbitrarily in a good many instances, since it was necessary to choose from several occupations, no one of which occurred as frequently as once among every one hundred high-school students. For example, the occupation of railroad conductor, or that of street-car motorman might have been selected instead of that of locomotive engineer. The merest glance through the table will show many more cases where the same method was necessarily followed and where the same criticism is pertinent. The larger occupational divisions, however, would probably appear in any large and representative high-school population just about as they do here.

COMPARISON WITH THE ADULT POPULATION

The analysis of the high-school population just presented gives the impression that the laboring classes do not constitute the preponderant element in the public high school. The reader also, in all probability, carries the impression from everyday experience that in the

TABLE X

PROBABLE OCCUPATIONS OF THE FATHERS OR GUARDIANS OF 100 HIGH-SCHOOL STUDENTS TAKEN AT RANDOM FROM THE HIGH-SCHOOL POPULATIONS OF BRIDGEPORT, MT. VERNON, ST. LOUIS, AND SEATTLE—ALL FOUR YEARS COMBINED

Banker	Cigar Merchant	Clothier	Druggist	Druggist	Dry-Goods Merchant	Fruit Merchant	Furniture Merchant	Grain Broker	Grocer
Grocer	Grocer	Hotel-Keeper	Manufacturer	Manufacturer	Manufacturer	Publisher	Restaurant-Keeper	Shoe Merchant	Undertaker
Wholesale Merchant	Architect	Civil Engineer	Clergyman	Dentist	Editor	Lawyer	Musician	Pharmacist	Physician
Teacher	Building Contractor	Building Contractor	Building Contractor	Factory Foreman	Factory Foreman	Factory Foreman	Factory Superintendent	Factory Superintendent	Labor-Union Official
Lumber Inspector	Manager Express Company	Manager Theater	Police Captain	Railroad Agent	Sales Manager	Superintendent Post-Office	Yard Foreman	Buyer	Commercial Traveler
Commercial Traveler	Insurance Agent	Insurance Agent	Real Estate Agent	Real Estate Agent	Salesman in Store	Salesman in Store	Salesman in Store	Accountant	Bookkeeper
Cashier	Postal Clerk	Railroad Clerk	Receiving Clerk	Farmer	Farmer	Gardener	Baker (Proprietor)	Barber (Proprietor)	Cobbler (Proprietor)
Tailor (Proprietor)	Cabinet-Maker	Carpenter	Carpenter	Electrician	Mason	Painter	Plasterer	Plumber	Auto-Mechanic
Blacksmith	Boiler-Maker	Machinist	Machinist	Molder	Stationary Engineer	Compositor	Baker	Cigar-Maker	Tailor
Weaver	Chauffeur	Driver	Locomotive Engineer	Street-Car Conductor	Switchman	City Fireman	Policeman	Janitor	Laborer

ordinary American city a large proportion of the population, if not a majority, are manual laborers. An attempt will now be made to discover the relation between the representation of each of the occupational groups in the general population and its representation in the high school.

The problem is complicated somewhat because of the well-known fact that certain of the occupations are carried on in large measure by young people. This is true of the clerical occupations, for example, certain commerical occupations, many of the miscellaneous trades, common labor, and others. Obviously it would not do therefore to compare the number of children in high school from a certain occupational group with the total number of persons engaged in that set of occupations. The occupation recruiting its ranks largely from persons on the youthful side of middle life could not possibly have a large proportion of children of high-school age. In attacking the problem two things are necessary: first, a knowledge of the age of the fathers of high-school students; and second, a knowledge of the number of men of this age to be found in each group of occupations.

The first of these two tasks is an easy one. It would not be difficult to make a rough estimate of the probable age-distribution of the fathers of high-school students from our knowledge of biological laws. It is not necessary to rely on such an *a priori* judgment, however, since the facts were obtained from the entire student population of one of the large Seattle high schools. Table XI is derived from the data furnished by these students. According to these figures an age-period of twenty years, the period from 40 to 60, includes over 80 per cent of the fathers; and the median age is 48.5 years. Since this particular high school draws its student body from no special social class, facts from other communities would probably parallel these rather closely.

TABLE XI

PROBABLE AGE-DISTRIBUTION OF THE FATHERS OF 1,000 HIGH-SCHOOL STUDENTS DERIVED FROM DATA GIVEN BY 1,391 STUDENTS IN LINCOLN HIGH SCHOOL, SEATTLE

Age-Period	30–4	35–9	40–4	45–9	50–4	55–9	60–4	65–9	70–4	75–9	Total	Median
Number.........	7	83	218	278	229	102	59	17	5	2	1,000	48.5

The second task, involving the determination of the number of men of the foregoing ages in these cities engaged in each set of occupations, is not so easy. In the first place, the occupational census for 1920 is not yet available. It is therefore necessary to place reliance on the data presented in the previous census, that of 1910. It is improbable, however, that the occupational distribution of the population in any city has changed in any marked degree during the past ten years. Consequently this may not be regarded as a source of serious error.

In the second place the age-periods recognized in the occupational census are not exactly the periods that would be most serviceable for this study. Furthermore, in the distribution of occupations by age-periods, the facts are not given for all occupations nor for all cities, but only for certain selected callings in each of the cities of more than 100,000 inhabitants. The only complete occupational census includes in a single figure the entire number of males over ten years of age pursuing each occupation. Thus for Bridgeport, St. Louis, and Seattle the number of males engaged in certain selected occupations is given by the following age-periods: ten to thirteen years; fourteen to fifteen; sixteen to twenty; twenty-one to forty-four; and forty-five years and over.

In view of these facts it was decided to merely make the best possible estimate of the number of males over forty-five years of age in each of the four cities engaged in each of the occupational divisions used in this study. This was done by first tabulating the total number of males over ten years of age to be found in each of these divisions in each of the four cities. Then, for each of the three larger cities, the selected occupations, for which the detailed age-distribution was given, were arranged under the classification used here, and the proportion of males over forty-five years of age was noted. The results of this calculation are given in Table XII. The wide range in the proportion of workers in the various occupations who are over forty-five years of age is at once apparent. At the one extreme are the managerial occupations in which 36 per cent of the workers are in this age-group; at the other are the clerical pursuits in which this percentage is but 14.

Perhaps the reader has already observed that two of the occupational divisions used in our classification do not appear in Table XII, namely, agricultural service and the artisan-proprietors. The first was not included because the agricultural occupations do not constitute a normal part of the life of the city. Many of the high-school students from this source are living in the city for the purpose of attending school. There is consequently no natural relation between the number of children in the high school whose fathers are engaged in these occupations and the number of adults so engaged, according to the census. The artisan-proprietors were omitted from this table, because in the census report they are not distinguished from the retail dealers and the manufacturers on the one hand and the artisans on the other.

TABLE XII

PERCENTAGE OF MALES ENGAGED IN EACH OCCUPATION WHO ARE FORTY-FIVE YEARS OF AGE AND OVER, DERIVED FROM THE CENSUS FIGURES FOR SELECTED OCCUPATIONS IN BRIDGEPORT, ST. LOUIS, AND SEATTLE (1910)

Occupation	Percentage Forty-five Years or Over
Proprietors	35
Professional service	28
Managerial service	36
Commercial service	19
Clerical service	14
Building trades	27
Machine trades	24
Printing trades	16
Miscellaneous trades	17
Transportation service	17
Public service	30
Personal service	18
Miners, lumber-workers, fishermen	20
Common labor	20

Going back now to the total number of males over ten years of age engaged in each set of occupations in the four cities and applying the percentages given in Table XII, it is possible to approximate the actual number of men over forty-five to be found in these pursuits in 1910. This figure, along with the number of high-school students whose fathers or guardians are engaged in the same occupations, is given in Table XIII. The relation between these two sets of figures is also given in this table in terms of the number of students in the high schools of these four cities from each occupational group for every 1,000 men over forty-five engaged in the same occupations. This relation is really the final object of this rather extended series of computations and calculations.

This table shows very clearly that certain of the occupational groups have a much better representation in the high school than others in proportion to their representation in that part of our population in which the fathers of children of high-school age are found. Since these same facts are presented graphically in Figure 2, the reader's time will be economized by directing his attention to it at once. A hasty survey of the diagram shows that the laboring groups suffer in the comparison,

TABLE XIII

ESTIMATED NUMBER OF MEN FORTY-FIVE YEARS OF AGE AND OVER ENGAGED IN EACH SET OF OCCUPATIONS IN BRIDGEPORT, MT. VERNON, ST. LOUIS, AND SEATTLE (1910); NUMBER OF HIGH-SCHOOL STUDENTS WHOSE FATHERS OR GUARDIANS ARE ENGAGED IN EACH SET OF OCCUPATIONS IN THE SAME CITIES, ACCORDING TO STUDIES MADE IN 1919–20 AND 1920–21; AND NUMBER OF THE LATTER FOR EVERY 1,000 OF THE FORMER FOR EACH SET OF OCCUPATIONS

Parental Occupation	Men Forty-five Years of Age and Over	Students in High School	Number in High School for Every 1,000 Men Forty-five Years and Over
Proprietors	11,135	3,799	341
Professional service	4,520	1,629	360
Managerial service	7,120	2,846	400
Commercial service	6,682	1,637	245
Clerical service	4,558	996	219
Building trades	9,872	1,433	145
Machine trades	7,681	1,300	169
Printing trades	845	186	220
Miscellaneous trades	7,881	809	103
Transportation service	5,793	850	157
Public service	1,560	270	173
Personal service	4,941	249	50
Miners, lumber-workers, and fishermen	1,142	66	58
Common labor	12,429	213	17
Total	86,159	16,283	189

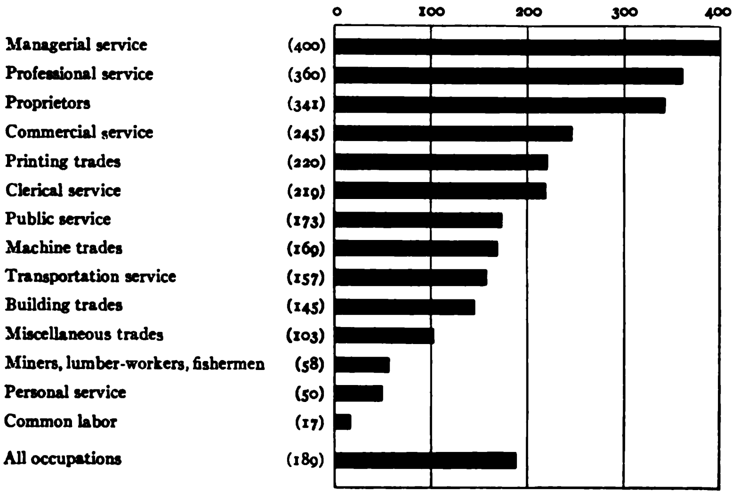

FIG. 2.—Showing the number of children in the high schools of four cities (Bridgeport, Mt. Vernon, St. Louis, Seattle) from each occupational group for every 1,000 males over forty-five years of age engaged in that occupation in the four cities, according to the Federal Census for 1910. Data from 16,283 high-school students.

and some of them suffer very badly. Note the two extremes, for example. Managerial service leads with 400 students in high school to every 1,000 men over forty-five in the general population. At the other end of the series is common labor with but seventeen. The one labor group that stands out with a good record is the printing trades. It is one point ahead of one of the non-labor groups, clerical service. This is probably to be explained in terms of the superior education of persons engaged in the printing industry, the associations formed in the occupation, and the stability of employment. The favorable position of the public service is probably to be explained in the same way.

A word of criticism is pertinent here. In the light of other findings of the study to be presented in later chapters there is reason to believe that the order of the groups at the upper end of the diagram is not altogether correct, due to certain difficulties arising from the effort to translate the classification of the census over into the classification used in this study. The managerial service certainly should not rank first, but it gets that rank here because the census does not in all cases draw a clear line between managers and owners. Also there are probably a considerable number of individuals returned as commercial workers who occupy managerial positions in commerce. Consequently the number of persons in the directing occupations is reported as somewhat smaller than the actual facts would warrant. This results in a larger proportionate representation in high school. Commercial service, on the other hand, should rank somewhat higher than it is placed here. This group of workers is probably diluted in the census report by the inclusion of a considerable number of clerical workers, due to the ambiguity in the meaning of the term *clerk*. The order of the first four groups should probably be as follows: professional service, proprietors, commercial service, and managerial service. The evidence favoring this order will be noted from time to time in this study.

It is probable, for three reasons, that the proportion of children in high school from the laboring groups is somewhat smaller than this diagram suggests. In the first place, the acceptance of the number of men over forty-five in each occupation as the basis for comparison gives a certain advantage to those occupations in which the proportion of such men is relatively small, because over 30 per cent of the fathers of high-school students are under forty-five. As a consequence, the occupations engaging few men beyond this age are not given a representation in the general population proportionate to the actual number of fathers of high-school students to be found in them. Since on the average the laboring classes are recruited less from the older men than are the other groups, it is apparent that the procedure followed here favors them. Of course, among the non-labor groups, it is true that the clerical and commercial workers are likewise favored. In the second place, the average number of children per family among the manual laborers is somewhat larger than it is among the other classes of the population. This is especially true of the lower grades of labor. Therefore, if the children from these elements in the population were enrolled in the high school in proportionate numbers, their ratio to the number of adults of the parental age in the same population groups should be larger than that for children from other classes with a lower birth-rate. In the third place, earlier marriages and a higher marriage rate among the laboring classes than among the more well-to-do members of society work toward the same end. These considerations should incline us therefore toward a revision of Table IX and Figure 2 in the direction of larger rather than smaller differences between the two extremes.

CHAPTER VI

PARENTAL OCCUPATION AND PROGRESS THROUGH THE SCHOOL

In the previous chapter the character of the total high-school population has been under examination. The proportionately larger representation of the proprietors, professionals, managers, and commercial workers was noted. In this chapter the composition of the school population in the earlier years will be compared with that in the later years. For this analysis we have data from the students in each of the four years in the high schools of the four cities and from the pupils of the sixth grade in Mt. Vernon.

THE FRESHMAN AND SENIOR YEARS

All are familiar with the fact that the number of students in the Senior year of the high school is but a small fraction of the total high-school enrolment, far below the 25 per cent that would result if the same number of young people entered the Freshman class every year, if all were promoted regularly, if there were no deaths or eliminations, and if there were no accretions except at the beginning of the first year. According to the report of the Bureau of Education for 1917–18, the students in the first year of the high school constituted 39.8 per cent of the total high-school enrolment in the United States; those in the second year, 26.9 per cent; those in the third year 18.8 per cent; and those in the fourth year but 14.5 per cent. The relatively small proportion in the last year of the high school is due chiefly to two causes, namely, elimination and the increasing size of the Freshman class, the latter resulting from the normal population increase and the increasing interest in secondary education on the part of children and their parents.

Because of the small number of students in the Senior year it is naturally assumed that some sort of selection is going on continually in the high school. Many studies have been made of the process of elimination and of the character of the eliminated. It is our purpose here to note the social composition of the student population in the last year as contrasted with the first. The facts for the four cities combined appear in Table XIV. For each of the two years the percentages of students coming from the various occupational groups are given. It is plain that the Senior class in these high schools does not differ from the Freshman class merely in the age of its students and their advancement in the course. The proportions coming from the different elements in the population are noticeably different. The children from the laboring classes constitute in every instance a smaller percentage of the total enrolment of the last than of the first year of the school. On the other hand a larger percentage of the Seniors than of the Freshmen are children of the proprietors, the professionals, the managers, and the commercial workers. Two groups make equal proportionate contributions to the two classes, namely, the clerical and agricultural workers.

TABLE XIV

Percentage of Students in Each of Two High-School Years from Each of the Occupational Groups in the High Schools of Bridgeport, Mt. Vernon, St. Louis, and Seattle: Data from 6,782 Freshmen and 2,522 Seniors

Parental Occupation	Freshman	Senior
Proprietors	17.7	22.9
Professional service	7.7	12.5
Managerial service	15.4	19.1
Commercial service	8.6	11.1
Clerical service	5.9	5.9
Agricultural service	2.3	2.3
Artisan-proprietors	4.4	3.5
Building trades	8.8	5.3
Machine trades	8.3	4.6
Printing trades	1.0	.8
Miscellaneous trades	4.8	2.3
Transportation service	6.2	3.6
Public service	1.7	1.1
Personal service	1.4	.9
Miners, lumber-workers, fishermen	.5	.3
Common labor	1.8	.6
Unknown	3.5	3.2
Total	100.0	100.0

These same facts under a slight adaptation are presented graphically in Figure 3. Here is shown for each group the number in the Senior year for every 100 from the same group in the Freshman year. This ratio that the one year bears toward the other exhibits a very wide range among the various occupations, as an inspection of the diagram clearly reveals. As a general proposition, those occupations having a relatively poor representation in the high school are just the ones with a small proportion in the Senior year. At the two extremes are professional service and common labor. For the former there are 60.2 students in the Senior year for every 100 in the Freshman year of the high school; whereas, for the latter this ratio is but 12.4. The facts for the Sophomore and Junior years, as might be assumed, show a condition intermediate between the two extreme years. They are therefore not given here. It seems that as we pass from year to year in the high school, we see the children from the laboring classes constituting a less and less important element of the student population.

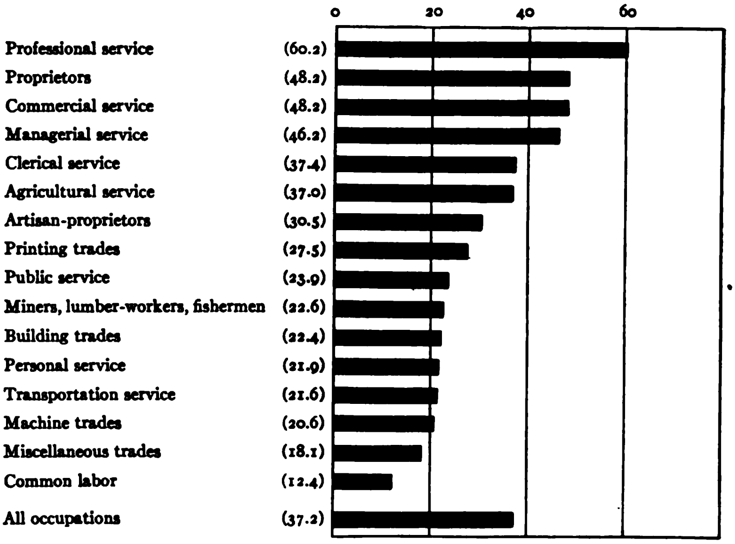

FIG. 3.—Showing for each occupational group the number of students in the Senior year for every 100 in the Freshman year of the high school. Data from Bridgeport, Mt. Vernon, St. Louis, and Seattle.

An analysis of the data from the different cities shows some differences, but they are quantitative rather than qualitative. The laboring classes hold their own better in some of the cities than they do in others, but in every instance their record is relatively inferior to that of the other groups. Thus the nine laboring groups (the building trades, machine trades, printing trades, miscellaneous trades, transportation service, public service, personal service, miners, lumber-workers, and fishermen, and common labor) contribute 26.5 per cent of the membership in the Senior class in Bridgeport; 23.3 per cent in Seattle; 15.2 per cent in St. Louis; and but 4.3 per cent in Mt. Vernon. These differences are, to be sure, accounted for in some measure by occupational differences in the populations of the several cities. The high proportion in Bridgeport is certainly largely explained in this way. Bridgeport is very highly industrialized. The laboring classes consequently constitute an exceptionally large element in the population. The very low percentage of children from these classes in the Senior year of Mt. Vernon is also to be explained largely in terms of the occupational character of the population itself. The records of Seattle and St. Louis, on the other hand, are not to be interpreted in this way. The large representation of the laboring groups in the former city is not due to their large numbers in the general population. As a matter of fact, they form a less important numerical group in Seattle than in St. Louis. The high schools of the former seem to hold the children of laborers unusually well.

THE SOCIAL COMPOSITION OF THE SIXTH GRADE

By the time the first year of the high school is reached the student population is already greatly reduced and presumably already considerably selected. It is fortunate therefore that for at least one of the cities, Mt. Vernon, facts regarding the social composition of the entire sixth grade were secured. Of course there are many children who do not even reach this point in our educational system, because of retardation and elimination. This group of children, therefore, may be assumed to be somewhat different socially from the children in the first grade, or from the children secured by taking a cross-section of the entire population at any particular age. It nevertheless provides us with significant data for comparative purposes.

The percentage of children from each of the occupational groups for both the sixth grade and the Senior year of the high school is given in Table XV. The difference between the first and last high-school years already noted is seen to be greatly accentuated. And it is probable that the difference would be somewhat greater in a city with a larger laboring population. Even here the majority of the children in the sixth grade come from the homes of laborers. This is certainly not true of the students in the Senior year of the high school. These two cross-sections of the school population give us two very different sociological pictures. They might almost be conceived as representative of two different social orders.

The contrast is so striking that it seems advisable to give it a graphical representation. This is done in Figure 4 by taking four occupational groups showing different tendencies and plotting a curve for each, picturing its percentage representation in the school population of each

TABLE XV

PERCENTAGE OF CHILDREN FROM EACH OCCUPATIONAL GROUP IN EACH OF TWO SCHOOL GRADES. DATA FROM 739 CHILDREN IN THE SIXTH GRADE AND 136 IN THE SENIOR YEAR OF THE HIGH SCHOOL, MT. VERNON

Parental Occupation	Sixth Grade	Senior Year of High School
Proprietors	13.1	29.4
Professional service	6.8	16.9
Managerial service	10.0	20.6
Commercial service	6.0	15.4
Clerical service	4.3	5.2
Agricultural service	2.3	.0
Artisan-proprietors	9.1	5.2
Building trades	16.5	.7
Machine trades	4.7	.7
Printing trades	.4	.0
Miscellaneous trades	5.2	2.2
Transportation service	4.2	.7
Public service	1.5	.0
Personal service	2.4	.0
Miners, lumber-workers, fishermen	.4	.0
Common labor	10.8	.0
Unknown	2.3	3.0
Total	100.0	100.0

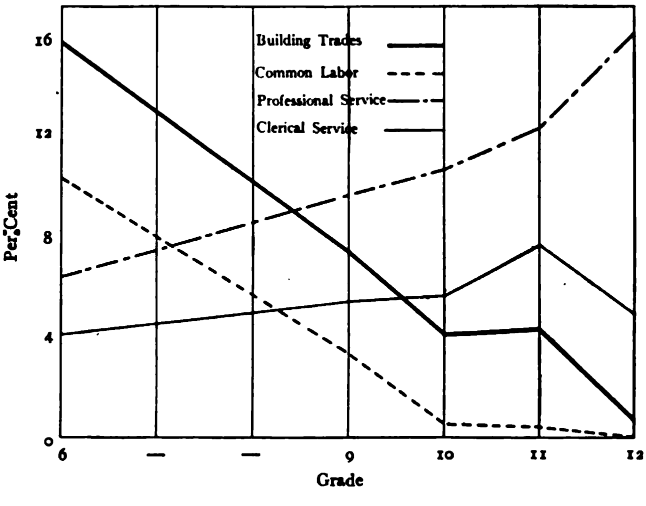

FIG. 4.—Showing percentage of children in each grade from the sixth to the twelfth whose fathers are engaged in each of four groups of occupations. Mt. Vernon, May, 1921. No data for seventh and eighth grades.

grade from the sixth to the twelfth. Since we have no data from the seventh and eighth grades the position of the curve in these grades for each group is purely hypothetical. Based on actual facts it would probably not follow exactly the course given it here, but its general direction would be the same. The diagram shows in an impressive way the diverse reactions of these four groups to educational opportunity. Each of the occupational divisions was chosen for a reason—common labor and professional service, because they represent the two extremes; clerical service because it represents an intermediate tendency; and the building trades because they constitute the largest labor group as well as the largest occupational group in the sixth grade. The proportion of children from the building trades and common labor in each grade diminishes very rapidly as we pass from one year to the next. The latter has practically disappeared in the Sophomore year, and the former are barely able to keep a slight representation until the end of the high school. Professional service, on the other hand, furnishes a constantly increasing percentage of the school population as progress is made through the schools. Clerical service improves its position slightly, but does little more than hold its own. The other non-labor groups show tendencies similar to those of professional service, and the remaining labor groups behave much as the building trades.

Perhaps one more chart bearing on this same matter will not tire the reader. In Figure 5 is shown for each occupational group the number of children in the Senior year of the high school for every one hundred in the sixth grade. Comment is hardly necessary. The diagram carries its own message. It brings out with peculiar force the enormous contrast between the school populations in these two years of the Mt. Vernon public schools.

Since the organization of most of the work in most of our high schools assumes four years of attendance, the number and character of the student population in the Senior year might be expected to afford one of the most satisfactory measures of the extension of secondary educational opportunity. The Senior class should tell much about the success of the high school in reaching the various elements in the population. It is for this group especially that the ordinary high school is maintained.

In the previous chapter the total high-school population was analyzed in the light of the social composition of that adult population from which children of high-school age come. This same thing is done for the students of the Senior year in Figure 6. Here is shown for each occupational group the number of students in the Senior year of the

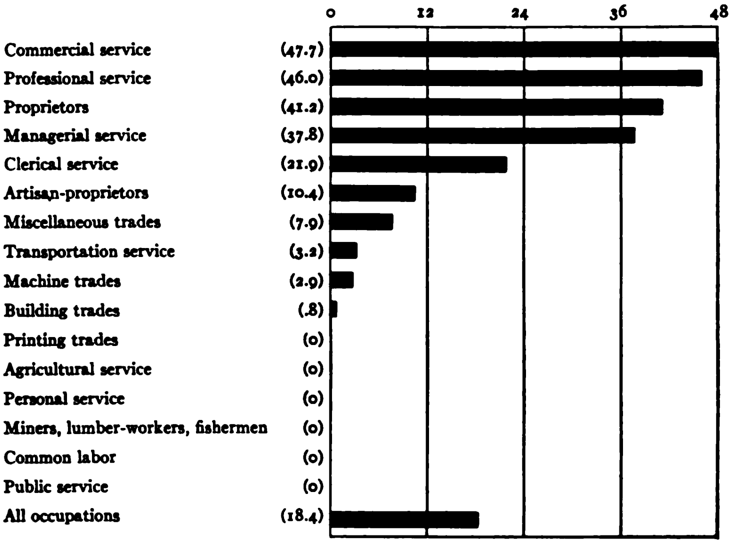

FIG. 5.—Showing for each occupational group the number of children in the Senior year of the high school for every 100 from the same group in the sixth grade of the elementary school. Mt. Vernon, May, 1921.

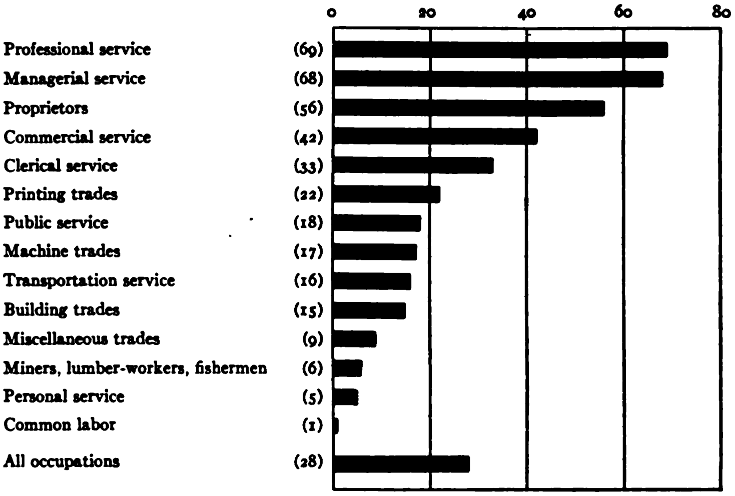

FIG. 6.—Showing the number of children in the Senior year of the high school in four cities (Bridgeport, Mt. Vernon, St. Louis, Seattle) from each occupational group for every 1,000 males over forty-five years of age engaged in that occupation in the four cities, according to the Federal Census for 1910. Data from 2,382 high-school Seniors.

high school in the four cities for every 1,000 men over forty-five years of age engaged in that occupation in these same cities, according to the thirteenth census. The reasons for choosing the number of males over forty-five as the basis for comparison have already been given, so need not be repeated. As might be expected from the data presented in this chapter thus far, the differences between the laboring and the non-laboring groups are greater here than for the total high-school population. It appears that the chances that the child of a father engaged in one of the professional pursuits will reach the Senior year of the high school are sixty-nine times as great as those of the child whose father is a common laborer. These two occupational classes represent the extremes. The others fall in between in a gradual series with the laboring groups at the lower end of the distribution.

Table XVI gives a concrete picture of the occupations represented in the Senior year of the high school as Table XI did for the entire high school. The same caution is necessary in interpreting this as was suggested in the discussion of the earlier table. Many of these particular occupations might not appear in a group of one hundred students selected at random from the Senior classes in the high schools of these four cities, but the larger groups of which these occupations are representative would. Nothing could show more plainly than this table that the students in the Senior year of the public high school are socially a highly selected group.

The objection may be raised here that the differences between the earlier and later years are due to the promotion of the fathers from less responsible to more responsible positions, or to their acquisition of property which enables them to set up business for themselves and thus enter the ranks of the proprietors. Obviously to the extent that this is going on during the period of high-school attendance the character of the student population in the Senior year will differ from that of the students in the Freshman year in the direction indicated in this chapter. If, for example, a goodly proportion of the fathers of high-school Freshmen who are engaged in manual labor are promoted to managerial positions or go into business for themselves as proprietors during the succeeding three years, the students in the Senior year whose fathers are engaged in the managerial occupations or as proprietors will show an increased proportion, even though there is no elimination whatsoever from high school in the meantime. It must be assumed of course at the same time that an equal number of fathers are not demoted from managerial positions or do not lose property, making it necessary for them to fall back into the ranks of labor.

TABLE XVI

PROBABLE OCCUPATIONS OF THE FATHERS OR GUARDIANS OF 100 HIGH-SCHOOL SENIORS TAKEN AT RANDOM FROM THE HIGH-SCHOOL POPULATIONS OF BRIDGEPORT, MT. VERNON, ST. LOUIS, AND SEATTLE

Banker	Cigar Merchant	Clothier	Clothier	Druggist	Druggist	Dry-Goods Merchant	Fruit Merchant	Furniture Merchant	Grain Broker
Grocer	Grocer	Grocer	Grocer	Hotel-Keeper	Manufacturer	Manufacturer	Manufacturer	Manufacturer	Publisher
Restaurant-Keeper	Shoe Merchant	Undertaker	Wholesale Merchant	Architect	Artist	Chemist	Civil Engineer	Clergyman	Dentist
Editor	Lawyer	Musician	Pharmacist	Physician	Surgeon	Teacher	Building Contractor	Building Contractor	Building Contractor
Factory Foreman	Factory Foreman	Factory Foreman	Factory Superintendent	Factory Superintendent	Insurance Official	Labor-Union Official	Lumber Inspector	Manager of Express Company	Manager of Grocery Store
Manager of Theater	Police Captain	Promoter	Railroad Agent	Sales Manager	Superintendent Post-Office	Yard Foreman	Buyer	Commercial Traveler	Commercial Traveler
Insurance Agent	Insurance Agent	Real Estate Agent	Real Estate Agent	Real Estate Agent	Salesman in Store	Salesman in Store	Salesman in Store	Salesman in Store	Accountant
Bookkeeper	Cashier	Postal Clerk	Railroad Clerk	Receiving Clerk	Farmer	Gardener	Baker (Proprietor)	Barber (Proprietor)	Cobbler (Proprietor)
Tailor (Proprietor)	Carpenter	Electrician	Mason	Painter	Plumber	Auto-Mechanic	Machinist	Machinist	Molder
Stationary Engineer	Compositor	Baker	Tailor	Chauffeur	Driver	Locomotive Engineer	Street-Car Conductor	Policeman	Janitor

Fortunately we have at hand the facts bearing on this question. For the purpose of securing information indicating the degree and nature of the change of occupation on the part of parents during the period of high-school attendance this question was asked the students in the St. Louis high schools: "What was your father's occupation three years ago?" The period of three years instead of four formed the basis of this question, because at any particular moment, such as the time when our study was made, the number of years between the Freshman and the Senior class is exactly three. A tabulation of the facts for the Senior year shows that during the three preceding years the fathers of but nine students out of a total of 1,030 had advanced from the laboring occupations into those five groups of occupations styled as non-laboring in this study. During the same period the fathers of seven of these students passed in the other direction, from the non-laboring to the laboring classes. This leaves a difference of less than two-tenths of 1 per cent to account for the enormous differences already noted between the Freshman and Senior years. An examination of the clerical occupations also revealed no evidence that the proportion of this group in the several high-school years is modified by either promotion or demotion. But two clerical workers were promoted to managerial positions, and two were demoted to clerical positions from the managerial. It seems that the fathers of practically all high-school students have reached that point in years where no promotion may be expected to take them out of the occupational classes they have reached. At this time in life there is apparently but a small, a negligible chance, that a man will change his occupation sufficiently to take him from one of these groups to another. All of which goes to show that socially the student population in the Senior year of the high school is highly selected as compared with that of the Freshman year or the earlier grades.

CHAPTER VII

PARENTAL OCCUPATION AND CHILDREN OF HIGH-SCHOOL AGE NOT IN HIGH SCHOOL

In order to throw additional light on this question of the selective character of the high school, four groups of children of high-school age not in high school were studied. Of these one was in Seattle and three in Bridgeport. Their social character will now be examined.

CHILDREN OF HIGH-SCHOOL AGE AT WORK IN SEATTLE

Information regarding the occupations of the fathers or guardians of 514 children of high-school age (fourteen to seventeen years inclusive) at work in the commercial and industrial establishments of Seattle was obtained in December of 1919. These facts were secured through personal interviews with the children by field workers. The two sexes were almost equally well represented, there being 249 girls and 265 boys. Obviously this does not include all of the children of high-school age at work or not in high school, but the number is large enough to be representative.

Percentage data from this investigation are presented in Table XVII in which a comparison is made between this group of children of high-school age at work and the total Seattle high-school population for which the occupational data were obtained. The small group in the high school classified as "unknown" in previous tables and diagrams was not recognized in the computation of percentages here.

A glance at the table suffices to show the profound differences between the two groups. The proprietors, professional service, managerial service, clerical service, agricultural service, artisan-proprietors, and printing trades have better proportionate representation in the high school than out. This is especially pronounced for the first four groups. The favorable balance for the farmers and the clerical workers is not so marked. The printing trades have the best record among the labor groups, but the number of cases is so small that the conclusions drawn should not be too rigid. The artisan-proprietors also make a very good showing, but the returns on this group are so subject to error because of insufficient data that the comparison certainly does not represent the actual situation. On the other hand, the laboring groups, as a rule, appear in a rather poor light. Taken together and excluding the farmers they account for over 75 per cent of the children of high-school age at work. Without doubt the poorest showing is that made by common labor, while the best seems to be that made by the proprietors.

TABLE XVII

PERCENTAGE DISTRIBUTION OF THE OCCUPATIONS OF THE FATHERS OR GUARDIANS OF TWO GROUPS OF CHILDREN. DATA FROM 514 CHILDREN OF HIGH-SCHOOL AGE AT WORK AND 6,138 CHILDREN IN HIGH SCHOOL, SEATTLE

Parental Occupation	Children of High-School Age at Work	Children in High School
Proprietors	2.5	17.4
Professional service	4.1	11.4
Managerial service	8.2	17.1
Commercial service	2.7	8.7
Clerical service	3.5	4.6
Agricultural service	3.9	4.8
Artisan-proprietors	.2	2.6
Building trades	24.3	11.8
Machine trades	11.1	7.4
Printing trades	.2	1.1
Miscellaneous trades	5.8	2.0
Transportation service	9.5	5.6
Public service	2.5	1.5
Personal service	1.8	1.6
Miners, lumber-workers, fishermen	3.7	1.0
Common labor	16.0	1.4
Total	100.0	100.0

In Figure 7 this comparison between the children in high school and those outside is put in graphical form. For each occupational group it shows the number of children among those at work for every one hundred from the same group attending high school. It should be remembered, however, that data were secured from but 514 children at work which is only 8 per cent of the number studied in the high school. This diagram speaks for itself in unmistakable terms. The ratio ranges all the way from 93 for common labor to 1 for the proprietors.

Perhaps it is surprising to the reader that the managerial and professional occupations do have so large a representation outside the high school, and it was somewhat of a surprise to the writer. It is due in part to the difficulties of occupational classification already referred to. At best, there is a wide range in each of these groups. The major portion of the managerial group was made up of foremen and people holding relatively low-grade positions. The same may be said of the other group. The designation musician, for instance, has a rather wide range of meaning. Yet, it must be said, that among the professional occupations the clergymen had the largest representation. This may be accounted for in part on the grounds suggested above, since the prophetic gift, independent of a thorough and rigorous professional preparation, may be regarded as sufficient qualification for entry into the ministry. There was evidence, however, to show that in this group were several boys who had run away from home. This sort of thing occurs in every one of the groups, as well as other serious misfortunes, such as separation of parents, invalidism or death of the father.

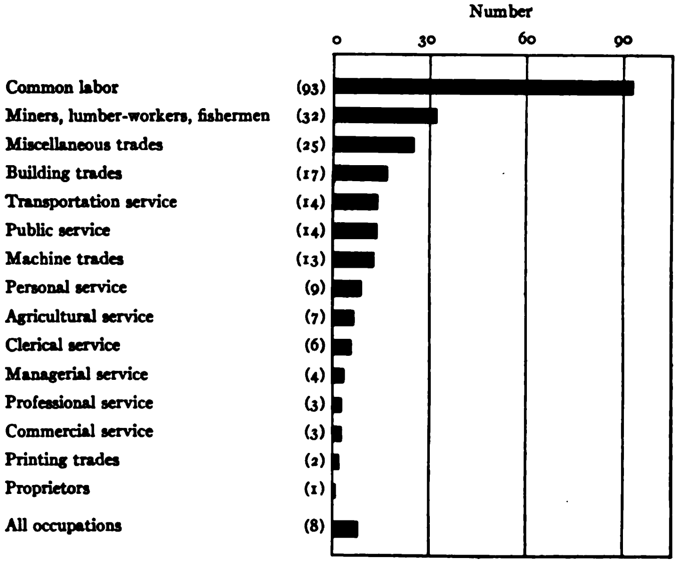

FIG. 7.—Showing the number of children from each occupational group among children of high-school age at work for every 100 children from the same group attending high school. Data from 6,387 children in high school and 514 at work. Seattle, 1919–20.

THE BRIDGEPORT EVENING HIGH SCHOOL

In Bridgeport three groups were studied, not exhaustively, but sufficiently to provide comparative data. As already stated, they were the evening high school, the state trade school, and the compulsory continuation classes, the latter being maintained in the evening for children from fourteen to sixteen years of age who have left school without having completed the elementary school.

The students in the evening high school constitute an interesting group, since, presumably, they are young persons desirous of further education who, because of some misfortune, are compelled to engage in gainful employment during the regular working-day. They are attending school during the hours which most young people use for recreation and entertainment. This speaks well for their moral qualities.

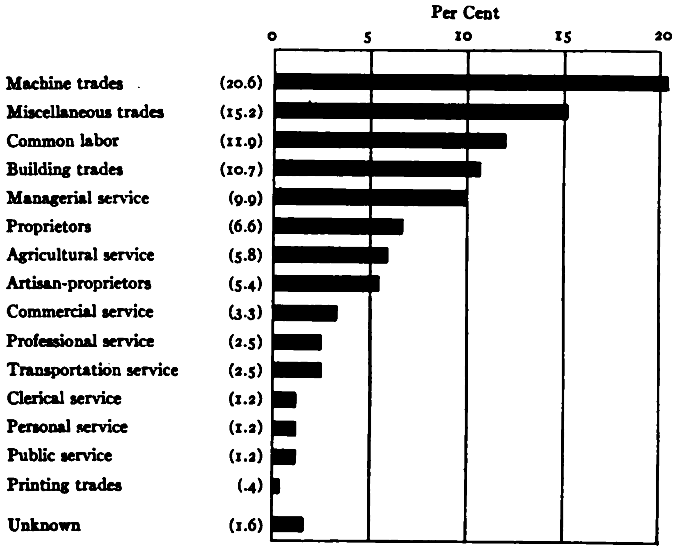

FIG. 8.—Showing by percentages the occupations of the fathers of 243 students attending the high-school department of the evening school. Bridgeport, December, 1920.

The enrolment in this school is approximately one thousand. It is a somewhat heterogeneous group, including a few students who are high-school graduates as well as great numbers of persons well beyond the high-school age. They are registered not only in the high-school department, which provides a sequence and variety of courses comparable to the course of study of the regular day high school, but also in special courses and subjects of considerable diversity. The 243 students whose records are used in this study were enrolled in the high-school department, were not high-school graduates, and were all twenty-one years of age or under. Of these 147 were girls and 96 were boys. The median age of the girls was 17.9; that of the boys, 18.6; and that of the two sexes combined, 18.2. Thus we have a group, slightly older than the regular high-school population, yet comparable to it in most respects.

Figure 8 shows the occupational distribution of the fathers of these 243 young people. It will be observed that the four leading groups are labor groups, with common labor occupying the third place. A re-examination of Table IX, portraying the social composition of the population of the day high school, is of interest here. It is clear that the two populations are very different. In the high school the proprietors and the managerial occupations are in first and second places, whereas in the evening high school they hold sixth and fifth places respectively. This excellent representation of certain of the labor groups apparently indicates the existence of many young people among them who are ambitious for larger educational opportunities.

THE STATE TRADE SCHOOL AT BRIDGEPORT

The trade school at Bridgeport is supported and administered by the state of Connecticut under the provisions of the Smith-Hughes Act. Its purpose is therefore intensely practical and it aims to turn out efficient workmen with only as much theory as is necessary to serve this purpose. It does this by providing a 4,800-hour course in each of fifteen trades, covering a period of two years and organized on the regular eight-hour basis now common in industry. There is no official connection with the city schools, although recently there has been inaugurated a co-operative course in industrial arts in which the academic training is given in the city high school and the trade training in the trade school. But it should be borne in mind that this school points very definitely into industry and those who enter it have renounced all intention of pursuing a higher education.

The school has a registration of approximately 400 students of which the great majority are boys. The information card was filled out by 198 students of whom 129 were in the first year and 69 in the second; 14 were girls and 184 were boys. The returns were not complete because many of the boys were only half-time students and others were out on project work. Then, too, a portion of the enrolment was composed of soldiers who were far beyond the high-school age. Records from this group were not wanted. However, there is no reason for believing that the group studied is not representative of the trade-school population generally.

Figure 9 shows the occupational distribution of the fathers of these 198 students. The same four great labor groups lead here as in the evening high school, except that common labor has forged ahead of the miscellaneous trades. On the whole, the labor groups are somewhat better represented in the trade school than in the evening high school, while it naturally follows that the reverse is true for the non-labor groups.. And a comparison of the trade school with the regular day high school shows two markedly different groups of children from the standpoint of the population sources from which they come. As a matter of fact, 54.7 per cent of the students in the high school come from the five non-labor groups (proprietors, professional, managerial, commercial, and clerical occupations), while but 17.7 per cent of the trade-school students come from these same five occupational classes.

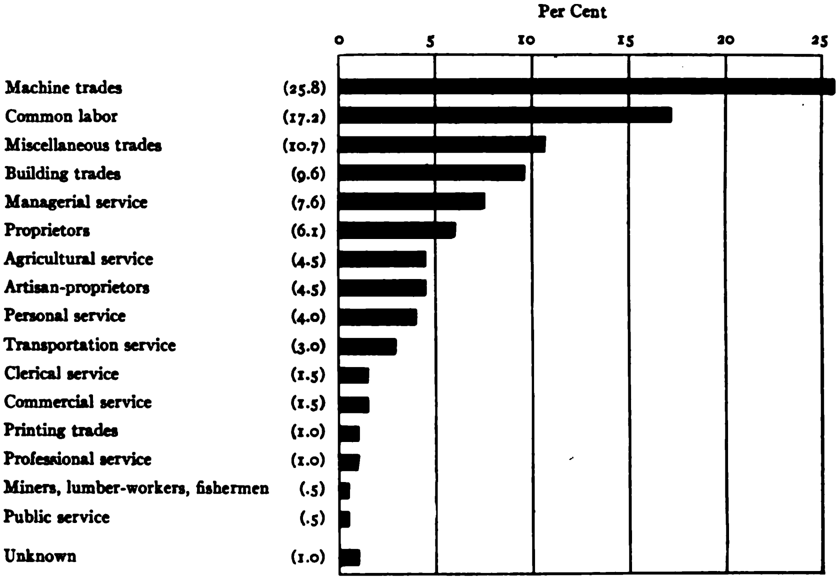

FIG. 9.—Showing by percentages the occupations of the fathers of 198 students in the state trade school. Bridgeport, February, 1921.

THE COMPULSORY CONTINUATION CLASSES OF BRIDGEPORT

In the compulsory continuation classes of the Bridgeport evening school is found a most interesting group of children for the student of education. Many of the "problems" of elementary education are found in these classes. As already intimated, Connecticut has a state law that compels children from fourteen to sixteen years of age who have left school without completing the grades, to attend these evening classes until they either reach their sixteenth birthday or complete the eighth grade. There are consequently gathered into these classes great numbers of children unfortunate either by nature or by nurture. Here are the misfits, the children who cannot "get on" in the elementary school, those who have been educationally discouraged, those whose schooling has been interrupted in one way or another, children whose homes lack the educational stimulus, children who have no homes. About these children one thing is certain. It is this: Practically none of them will ever attend high school. They are a sampling of that great group of children still to be found in our cities and towns for whom the high school simply does not exist. At best, it is nothing more than a name to them. And it is for this reason particularly that they are introduced into this study.

There are probably about a thousand children enrolled in these classes which meet at those school buildings which are conveniently located. But the attendance is very irregular and the composition of the classes is continually changing because of the admission of new recruits from the elementary school and the mustering out of individual after individual following the sixteenth birthday. It should be pointed out, however, that a significant number do remain after they reach this age.

Sociological data were obtained from 579 children in these classes, 305 girls and 274 boys, which included practically all those in attendance on the evening the cards were passed out. As might be expected, many of the cards were incompletely filled out. Where the information missing was important the cards were sent back and the facts especially desired were secured in this way in most cases. The final result is fairly satisfactory for purposes of this study.

Figure 10 gives a good picture of the social composition of this group of children. The representation of the five non-labor groups has shrunk to 10.3 per cent, and over half of these are found in the managerial service alone. Most of them are labor foremen. The fathers of more than one-fourth (26.6) of the 579 children are common laborers, whereas but 1.7 per cent of the children in the high school come from this occupational group.

What amounts to a summary of the situation found in Bridgeport is given in Figure 11. Here a comparison is drawn between the high-school population, on the one hand, and these three groups of non-high-school children combined, on the other. The bars represent for each occupational class the number of children in the latter for every one hundred in the former. The tremendous difference between common labor and all

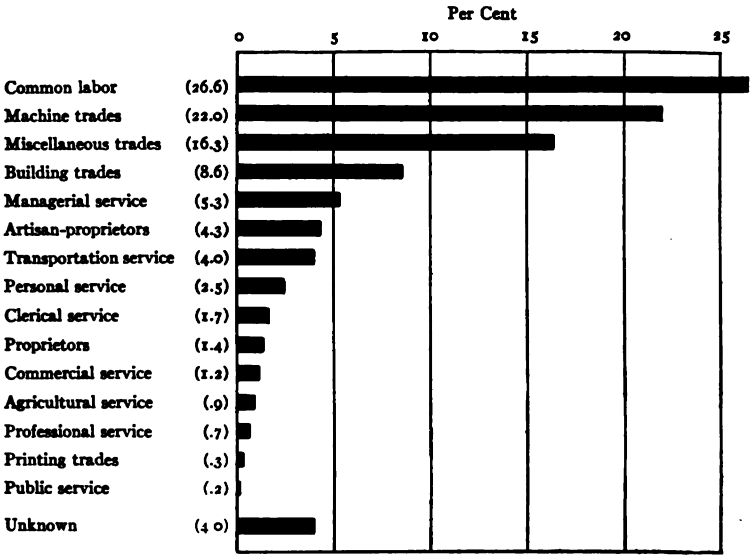

FIG. 10.—Showing by percentages the occupations of the fathers of 579 children attending the compulsory continuation classes of the evening school. Bridgeport, December, 1920.

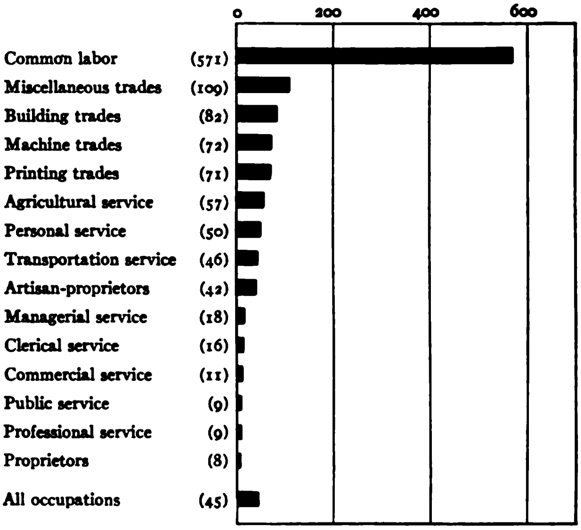

FIG. 11.—Showing the number of children from each occupational group among children of high-school age not in high school (evening high school, trade school, and compulsory continuation classes) for every 100 students from the same group attending the regular day high school. Data from 2,257 children in high school and 1,020 in the other three groups. Bridgeport, 1920–21.

the other groups is striking. As a matter of fact, all the labor groups occupy relatively unfavorable positions, except the workers in public service, who are found in third place. Too much weight, however, should not be attached to this exception because of the small number of cases involved.

In concluding this chapter, the reader's attention should be called to the similarity of the results obtained in Seattle and Bridgeport. It is clear that these groups of children of high-school age outside the regular high school are very different in social composition from the high-school population itself. The several occupational groups apparently arrange themselves in a graded series, with the proprietors and professional service at one end, and common labor at the other.

CHAPTER VIII

PARENTAL OCCUPATION AND THE COURSE OF STUDY

In response to the growing social demand for an enriched course of study the public high school has made many curriculum changes, particularly since the opening of the twentieth century. Among them is the organization of several curricula, each designed to meet the needs of some portion of the high-school population. Those who have been strong advocates of these adjustments have maintained that the single curriculum, pointing toward the higher education, is inadequate and involves an injustice to great masses of young people who cannot possibly go on to college. It will be interesting to see how children coming from the various occupational groups react to this ~~complex~~ program.

In each of the cities studied several different curricula are offered the students in its high schools. If all four cities offered the same curricula, it would be possible and desirable to discuss these curricula *seriatim*, bringing to bear on each curriculum the facts from all the cities. But such is not the case. Each city has organized its high-school course of study to suit itself, within certain limitations set by college-entrance requirements. Consequently the relation between parental occupation and course of study will be studied in each of the cities separately.

BRIDGEPORT

In the Bridgeport High School six curricula are offered the students. These are the college preparatory, scientific, general, normal, commercial, and industrial arts courses. Since the normal course is exclusively for girls and the industrial arts strictly for boys, this means five curricula for each sex. As will be noted later, however, several of these courses receive very light patronage.

Space will not permit a detailed description of each curriculum, and perhaps such a description is quite unnecessary, since the general content of most of them is familiar to anyone acquainted with the American public high school. The following brief characterization taken from the high-school circular to parents will have to suffice.

I. *The college preparatory course* prepares for the best colleges and universities as well as for the law and medical preparatory courses.

It stresses the traditional academic subjects with special emphasis on the languages.

II. *The scientific preparatory course* prepares for the best scientific and technical schools in the country. It differs from the college preparatory course merely in a larger provision for the study of science and mathematics at the expense of the languages.

III. *The general course* is designed to offer a broad and practical education to those who are not preparing for a college or a scientific school. Subject to the approval of the principal, the student is allowed extensive privileges of election.

IV. *The normal course* prepares students for the city normal school and offers a well-rounded and practical course with definite requirements for girls who are preparing for the important work of teaching.

V. *The commercial course* prepares rather definitely for clerical positions with the usual offerings in the special subjects.

VI. *The industrial arts course* is conducted through co-operation with the state trade school in which the shopwork is given. The course is either three or four years in length and is intended to train for the manufacturing and mechanical trades.

TABLE XVIII

SELECTION OF CURRICULA BY CHILDREN FROM THE VARIOUS OCCUPATIONAL GROUPS, BRIDGEPORT HIGH SCHOOL, ALL CLASSES

Parental Occupation	Girls						Boys					
	College	Normal	Commercial	General	Scientific	Total	College	Industrial	Commercial	General	Scientific	Total
Proprietors	88	57	81	1	2	229	105	4	20	6	87	222
Professional service	40	11	17	2	.....	70	25	2	2	1	37	67
Managerial service	39	74	92	6	.....	211	36	12	19	12	95	174
Commercial service	26	18	36	2	.....	82	31	1	15	1	33	81
Clerical service	11	16	33	3	.....	63	10	1	8	.....	16	35
Agricultural service	7	8	15	2	.....	32	1	3	5	3	5	17
Artisan-proprietors	5	16	42	.....	.....	63	21	1	5	1	20	48
Building trades	3	19	37	1	.....	60	15	2	9	2	28	56
Machine trades	8	45	111	4	.....	168	41	10	24	6	69	150
Printing trades	1	.....	2	.....	.....	3	2	.....	1	.....	1	4
Miscellaneous trades	6	23	51	1	1	82	26	4	6	2	19	57
Transportation service	2	14	23	.....	.....	39	12	1	9	2	14	38
Public service	5	10	21	.....	.....	36	5	.....	7	1	8	21
Personal service	1	6	20	.....	.....	27	5	1	6	1	12	25
Common labor	.....	2	14	.....	.....	16	4	2	9	1	6	22
Unknown	8	13	18	.....	.....	39	4	3	3	.....	10	20
Total	250	332	613	22	3	1,220	343	47	148	39	460	1,037

An examination of Table XVIII shows very few girls taking either the general or the scientific curriculum. Likewise, the number of boys in either the general or industrial arts course is small. This leaves but three courses each for the boys and girls.

The table reveals no pronounced tendency for the selection of courses among the boys to fall along occupational lines. Each of the three courses has a fairly good representation from all of the larger groups. It should be remembered, however, that so far as outlook is concerned, there is but little difference between the college and the scientific curricula.

Among the girls, on the other hand, a very different situation is found. The girls from the several occupational groups do show tendencies to gravitate toward certain courses. This is clearly brought out in Figure 12 and Figure 13. In the former the percentage of students from each of these groups taking the college preparatory course is compared with the percentage in the commercial course. At the one extreme are the girls whose fathers are engaged in the professional occupations, with 57.1 per cent in the college course and but 24.3 per cent in the commercial. At the other is the common labor group with not a single girl in the former course and 87.5 per cent in the latter.

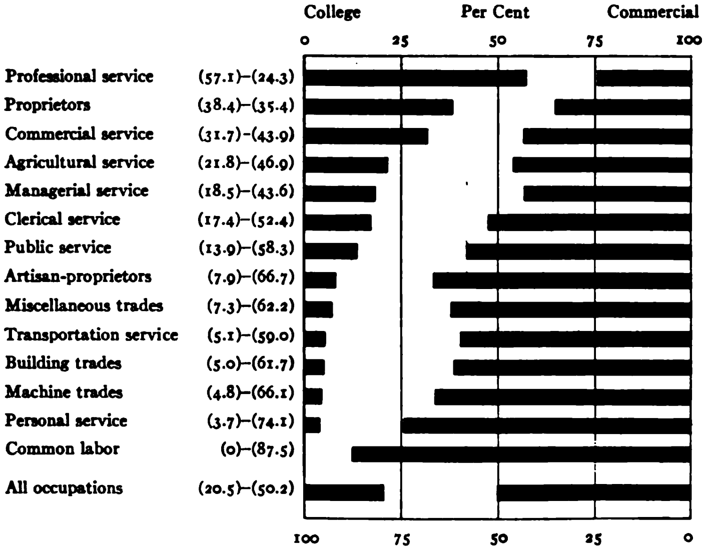

FIG. 12.—Showing the percentage of girls from each occupational group pursuing the college preparatory and commercial curricula, Bridgeport High School.

In Figure 13 the social composition of the entire group of girls pursuing the college preparatory curriculum in all four years is given. It shows in a striking way the class-character of this course. The first five groups, which may be regarded as the strictly non-labor groups, include 81.6 per cent of the total. Of the remaining 18.4 per cent, 2.8 are from the agricultural occupations; 2.0 from the artisan-proprietors; and 3.2 from fathers of unknown occupation. There remain but 10.4 per cent of these girls to represent the manual-labor groups. This tendency is yet more pronounced in the Senior year where 88.1 per cent come from the five non-labor groups and but 2.4 per cent from the labor groups.

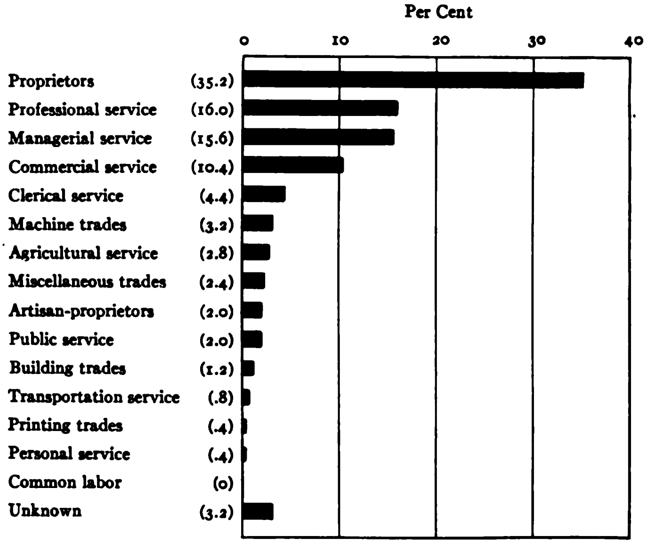

FIG. 13.—Showing by percentages the occupations of the fathers of the 250 girls pursuing the college preparatory course in the Bridgeport High School.

MT. VERNON

On a small scale Mt. Vernon is experimenting with the specialized high school. There are two separate school buildings. In the one, known as the Academic High School, are taught the classical, scientific, and general curricula; while in the other, a vocational school, the commercial and practical arts curricula are offered. The situation here is of especial interest to us because in the other three cities studied the high school is of the general type. Exception might be taken to this statement in its application to Bridgeport, for, although there is but one high school supported by the city, the state of Connecticut maintains a trade school there that enrols children of high-school age. It might, therefore, be maintained that in this city there are really two secondary schools, in one of which are taught the academic subjects; in the other, the practical arts.

In all, six curricula are offered, five for the boys and five for the girls. Of these, three are academic and three vocational. To the former belong the classical, scientific, and general; and to the latter, the commercial, industrial arts, and household arts courses. The vocational curricula are so organized as to make possible the granting of certificates for short units of work. A short description of each course follows.

I. *The classical course* is designed to meet the entrance requirements of college courses leading to the degree of Bachelor of Arts. Its distinctive feature is the requirement of three years of Latin and three years of either Greek, French, or Spanish.

II. *The scientific course* prepares for college courses leading to the degree of Bachelor of Science, as well as for engineering and technical schools. It consists of about equal parts of English, foreign languages, mathematics, and science.

III. *The general course* is rather elastic in its provisions and is organized to meet the needs of two classes of students: (1) those intending to enter a normal or training-school for teachers; and (2) those who will leave school at the end of the high-school course. The subjects, however, are all from the traditional academic offering.

IV. *The commercial course* includes the usual clerical and commercial branches, English, a little science and mathematics, and some provision for electives. It points toward wage-earning in the clerical occupations.

V. *The industrial arts course* prepares in a general way for industrial pursuits. It is organized under a liberal elective system with the single restriction that seven-twelfths of the time be given to subjects of an academic character and the remainder to industrial branches, including joinery and wood-turning, printing, machine-shop practice, etc.

VI. *The household arts course*, pointing toward homemaking, is organized according to the same principles as the course immediately preceding.

Facts showing the selection of curricula by the students from the various occupational groups are presented in Table XIX. Because of the small number of cases representing certain of the occupations, the data for the boys and girls are combined in a single table. For a similar reason the industrial arts and household arts curricula are brought together under the more general caption of "practical arts." This table gives for each occupational group the actual number and the percentage of students pursuing each of the curricula. It is interesting to note the great popularity of the classical course. Each of the curricula is well patronized except the practical arts course.

An examination of that half of the table giving the percentage of students from each group enrolled in each curriculum reveals tendencies of the order already noted in Bridgeport. If we take any one of the curricula we find a wide range in the emphasis given to it by children from the different occupations. Of course, in making these observations, too much weight should not be attached to the distribution for the occupations represented by very small numbers of students, such as the printing trades, personal service, public service, and the miners, lumber-workers, and fishermen. The curricula presenting the widest range are the classical and commercial courses. Fifty-eight per cent of the students whose fathers are engaged in professional service are taking the classical course, while but 5 per cent of the children of common laborers are pursuing this course. For the commercial course, this range is from 62 per cent for transportation service to 9 per cent for professional service. The range is not so large for the other three curricula, but it is considerable and large enough to be significant. As a general thing, the scientific and general courses are patronized in greater proportion by the non-labor groups, while the reverse is true for the practical arts course.

Since the Mt. Vernon High School system consists of an academic and a vocational school, it is of interest to note the differences in the social composition of the students attending the two institutions. This is easily done by combining the data for the three academic curricula, on the one hand, and for the two vocational curricula on the other, as presented in Table XIX. The results of this process, followed by a reduction to percentages, are given in Table XX. A glance at this table makes it clear that these two high schools are appealing to different elements in the population. It seems that the children of laborers who do go to high school attend the vocational school almost altogether. To be sure, the non-labor groups also send a reasonable proportion of their children to this school but they exhibit a strong inclination to favor the academic school. They supply 84.6 per cent of the students in the latter and but 47.1 per cent of those in the former.

TABLE XIX

NUMBER AND PERCENTAGE OF STUDENTS FROM EACH OCCUPATIONAL GROUP PURSUING EACH OF THE FIVE CURRICULA. BOYS AND GIRLS COMBINED. MT. VERNON HIGH SCHOOL

PARENTAL OCCUPATION	NUMBER						PERCENTAGE					
	Classical	Scientific	General	Practical Arts	Commercial	Total	Classical	Scientific	General	Practical Arts	Commercial	Total
Proprietors	143	40	66	3	52	304	47	13	22	1	17	100
Professional service	74	18	22	3	11	128	58	14	17	2	9	100
Managerial service	78	26	45	4	28	181	43	14	25	2	16	100
Commercial service	47	16	39	2	18	122	39	13	32	2	14	100
Clerical service	20	9	15	2	21	67	30	13	23	3	31	100
Agricultural service	1	1	1	3	5	11	9	9	9	28	45	100
Artisan-proprietors	18	5	13	1	19	56	32	9	23	2	34	100
Building trades	8	4	3	10	32	57	14	7	5	18	56	100
Machine trades	3	1	3	4	14	25	12	4	12	16	56	100
Printing trades	1	1	1	....	1	4	25	25	25	....	25	100
Miscellaneous trades	9	1	4	2	16	32	28	3	13	6	50	100
Transportation service	4	2	4	....	16	26	15	8	15	....	62	100
Public service	1	....	....	3	5	9	11	....	....	33	56	100
Personal service	....	....	2	1	3	6	....	....	33	17	50	100
Miners, lumber-workers, fishermen	....	....	....	....	1	1	....	....	....	....	100	100
Common labor	1	2	1	5	9	18	5	11	6	28	50	100
Unknown	11	5	9	1	11	37	30	13	24	3	30	100
Total	419	131	228	44	262	1,084	39	12	21	4	24	100

TABLE XX

PERCENTAGE OF STUDENTS IN EACH OF THE MT. VERNON HIGH SCHOOLS COMING FROM EACH OCCUPATIONAL GROUP

Parental Occupation	Academic High School	Vocational High School
Proprietors	32.0	18.0
Professional service	14.7	4.6
Managerial service	19.2	10.5
Commercial service	13.1	6.5
Clerical service	5.6	7.5
Artisan-proprietors	4.6	6.5
Agricultural service	.4	2.6
Building trades	1.9	13.8
Machine trades	.9	5.9
Printing trades	.4	.3
Miscellaneous trades	1.8	5.9
Transportation service	1.3	5.2
Public service	.1	2.6
Personal service	.3	1.3
Miners, lumber-workers, fishermen	.0	.3
Common labor	.5	4.6
Unknown	3.2	3.9
Total	100.0	100.0

In Figure 14 an attempt has been made to measure the relative attractiveness of the two schools to the several occupational divisions. It is based on the number of children in the vocational school for every one hundred from the same group in the academic school. In order to get numbers sufficiently large to insure reliability, several of the labor groups were combined, as indicated in the diagram. The difference between the two extremes is indeed striking. The proportion of children from the professionals, the commercial workers, the managers, and the proprietors attending the vocational school is very small. The reverse is true for the children of the laboring classes, particularly laborers of the lower grades. The clerical workers and the artisan-proprietors occupy an intermediate position.

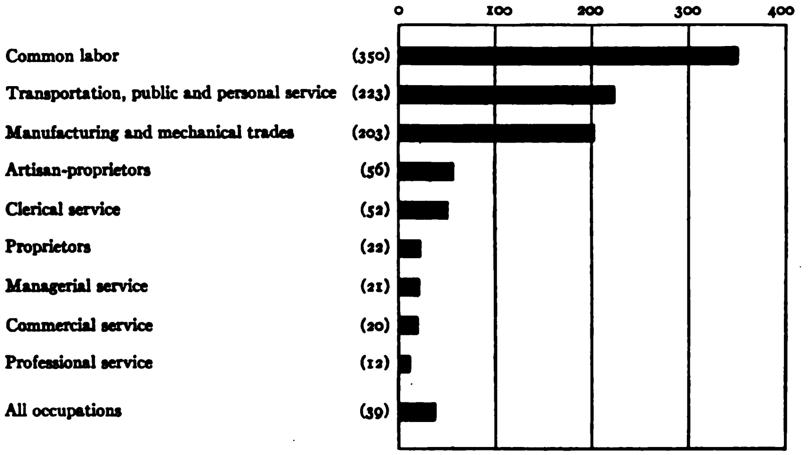

FIG. 14.—Showing for each occupational group the number of students (both sexes and all classes) in the vocational high school for every 100 from the same group in the academic high school. Data from 306 students in the former and 778 in the latter. Mt. Vernon.

ST. LOUIS

The course of study in the St. Louis High Schools is more complex than that in any of the other cities studied. There are four-year, two-year, and one-year courses. Altogether, thirteen different curricula are offered, of which two are for girls exclusively, three for boys only, and eight for both boys and girls. The following descriptive statements adapted from the printed outlines distributed to the parents will give the reader some notion of the character of these curricula:

I. *Four-year courses.*—Seven four-year courses are offered with a basic requirement of one half-year community civics, one half-year of vocations, three or four years of English, and one or more years of history common to all. These curricula with their distinctive features are:

1. *General course.*—One or more years of science and other subjects to be chosen from specified lists for each half-year. In the third and fourth years of this course, there is a wide election offered, including units peculiar to other courses.
2. *Scientific course.*—Four years of mathematics; four years of science; two or three years of a foreign language.
3. *Classical course.*—Four years of Latin; two or three years of one other foreign language, if elected; one, two, or three years of mathematics, if elected; one or two years of science.
4. *Fine-arts course.*—Four years of art or music; one or more years of science; one or more years of mathematics, if elected; two or more years of a foreign language, if elected.
5. *Manual training course.*—Three or four years of manual training; three or four years of mechanical drawing; two, three, or four years of mathematics; one, two, or three years of science; two years of a foreign language, if elected.
6. *Home economics course.*—Four years of household arts; three or four years of science; one, two, or three years of mathematics, if elected; and two or three years of a foreign language, if elected.
7. *Commercial course.*—Four years of commercial branches grouped in sequence; one, two, or three years of mathematics, if elected; one, two, or three years of science; two or three years of a foreign language, if elected.

II. *Two- and one-year vocational courses.*—Four two-year and two one-year vocational courses are offered. Very little academic material is included in these curricula. They are as follows:

1. *Two-year manual training course.*—Joinery, turning, pattern-making, forging, tool-making, machine-shop practice, mechanical drawing, English, mathematics, and physics.
2. *Two-year home economics course.*—Household arts, English, botany, physiology, and chemistry.
3. *Two-year commercial course.*—Business English, commercial arithmetic, civics, commercial geography, penmanship, bookkeeping, stenography, typewriting, and spelling.

4. *Two-year vocational course in printing.*—Printing, shop practice, English, drawing, civics, vocations, industrial history, shop mathematics.
5. *One-year bookkeeping course.*—Business English, commercial arithmetic, penmanship, spelling, bookkeeping, and typewriting.
6. *One-year stenographic course.*—Business English, spelling, stenography, and typewriting.

The number of children from each of the occupational groups pursuing each of the curricula is given in Table XXI for the entire high-school population. Separate data for the boys and girls are presented. For convenience, since the number taking either course is small, the one-year bookkeeping course and the one-year stenographic course are combined under the "one-year commercial course." A glance at the totals shows practically all the girls enrolled in four curricula, namely, the general, four-year commercial, four-year home economics, and two-year commercial. Likewise, almost 90 per cent of the boys are found in the general, scientific, four-year commercial, and four-year manual training courses. It is interesting to note the status of the classical course with its 67 boys and girls, a mere vestige that tells very little of its glorious past. This curriculum has undoubtedly seen better days. Several of the short vocational courses have not, as yet at least, gripped the attention of children of high-school age. With the other curricula offered it is clear that St. Louis is offering its children an enriched high-school curriculum.

Let us see how the boys and girls representing the different social groups react to this diversity of curricular opportunity. A careful examination shows practically the same tendencies at work here as those discovered in Bridgeport and Mt. Vernon. The case is not quite so clear, perhaps, because the lines between the courses are not so plain. St. Louis has no curriculum that can be regarded strictly as college preparatory, unless it be the little-patronized classical course. Perhaps the general course and the scientific course come nearest to it. At least, they do not point out into industry.

Among the girls the home economics course is apparently about equally popular with all the occupational groups, although some slight tendency toward a greater proportional representation in this course on the part of the non-labor groups is observable. This constitutes some evidence favorable to the contentions of certain critics of the courses offered in this field that they do not prepare for wage-earning. The four-year commercial course attracts the daughters of the manual

TABLE XXI

SELECTION OF CURRICULA BY CHILDREN FROM THE VARIOUS OCCUPATIONAL GROUPS, ST. LOUIS HIGH SCHOOLS (WHITE), ALL CLASSES

PARENTAL OCCUPATION	GIRLS										BOYS										
	General	Scientific	Commercial	Home Economics	Classical	Fine Arts	Two-Year Commercial	Two-Year Home Economics	One-Year Commercial	Total	General	Scientific	Commercial	Manual Training	Classical	Fine Arts	Two-Year Commercial	Two-Year Manual Training	Two-Year Printing	One-Year Commercial	Total
Proprietors	384	6	150	96	7	40	87	2	2	774	405	96	97	173	3	15	25	15	.....	.....	829
Professional service	211	2	39	32	13	19	20	1	1	338	197	37	7	60	8	3	8	3	.....	.....	323
Managerial service	344	4	140	65	9	32	80	1	3	678	248	48	50	147	3	10	23	20	1	.....	550
Commercial service	220	2	74	41	3	18	60	.....	3	421	194	33	46	88	3	5	14	12	1	1	397
Clerical service	151	.....	65	35	5	5	51	1	3	316	92	24	35	60	3	6	9	4	1	.....	234
Agricultural service	24	1	7	2	.....	2	8	.....	.....	44	10	1	4	2	.....	.....	1	1	.....	.....	19
Artisan-proprietors	55	2	48	26	.....	8	49	.....	3	191	65	26	40	42	1	1	17	13	2	.....	207
Building trades	59	2	64	18	2	3	80	.....	3	231	51	21	26	52	1	.....	19	25	2	.....	197
Machine trades	63	1	63	14	1	6	82	1	2	233	50	12	15	80	1	1	16	24	.....	.....	199
Printing trades	23	.....	13	5	.....	1	18	.....	.....	60	16	3	10	15	1	.....	4	1	.....	.....	50
Miscellaneous trades	37	.....	54	7	.....	.....	78	2	3	181	43	17	42	45	.....	2	16	14	2	.....	181
Transportation service	75	2	66	23	.....	4	51	4	3	228	54	8	32	44	.....	.....	14	16	1	.....	169
Public service	29	.....	21	2	.....	2	11	.....	1	66	17	1	5	13	2	.....	3	4	.....	.....	45
Personal service	12	.....	14	3	.....	2	16	.....	.....	47	12	2	4	8	.....	.....	6	2	.....	.....	34
Miners, lumber-workers, fishermen	1	.....	1	.....	.....	.....	2	.....	.....	4	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	1
Common labor	11	.....	8	1	.....	.....	22	1	.....	43	6	.....	6	4	.....	.....	5	4	.....	1	26
Unknown	55	1	34	7	1	3	19	1	2	123	40	6	14	19	.....	1	9	8	.....	1	98
Total	1,754	23	861	377	41	145	734	14	29	3,978	1,500	335	433	852	26	44	189	167	10	3	3,559

laborers more than the girls from other classes. But the most significant comparison is the one to be drawn between the general and the two-year commercial courses. In Table XXII this comparison is made. Here is given the percentage of the girls from each of the occupational groups found in these two curricula. On the one hand, professional service leads in the general course and takes last place in the two-year commercial course with 62.4 per cent and 5.9 per cent respectively of its representatives in the two courses. On the other hand, but 20.4 per cent of the girls whose fathers are engaged in the miscellaneous trades have chosen the first course; and 51.2 per cent of the daughters of common laborers are pursuing the second. The other groups fall in between these two extremes, with the non-labor groups inclining disproportionately toward the general course and the labor groups toward the two-year commercial course. Many other interesting observations will be made here by the careful reader.

TABLE XXII

PERCENTAGE OF GIRLS FROM EACH OCCUPATIONAL GROUP PURSUING THE GENERAL AND THE TWO-YEAR COMMERCIAL COURSES, ST. LOUIS HIGH SCHOOLS, ALL CLASSES, DECEMBER, 1920

Parental Occupation	General Course	Two-Year Commercial Course
Professional service	62.4	5.9
Agricultural service	54.5	18.2
Commercial service	52.3	14.3
Managerial service	50.7	11.8
Proprietors	49.6	11.2
Clerical service	47.8	16.1
Public service	43.9	16.7
Printing trades	38.3	30.0
Transportation service	32.9	22.4
Artisan-proprietors	28.8	25.7
Machine trades	27.0	35.2
Building trades	25.5	34.6
Common labor	25.5	51.2
Personal service	25.5	34.0
Miners, lumber-workers, fishermen	25.0	50.0
Miscellaneous trades	20.4	43.1
All occupations	44.1	18.5

As in Bridgeport, the boys appear to be less influenced in their choice of courses than the girls by the social groups from which they come. An examination of Table XXI shows the labor groups somewhat better represented in the commercial and manual training courses than the other groups, but only slightly so. This may mean that the outlook from the four courses, in which most of the boys are enrolled, is, after all, very much the same. The commercial course for the girls probably means preparation for a clerical position to be entered upon immediately after leaving school, whereas the same course taken by a boy may mean, particularly in the Middle West, college preparation. Data secured in response to the question about expectations following graduation suggest this conclusion. More evidence appears in Figure 15 in which is presented the percentage of the boys in each of the occupational classes registered in the one- and two-year vocational courses. Obviously these curricula do not point collegeward. Consequently, it is not surprising to see rather pronounced differences among the groups. Here is the already familiar order with common labor at one extreme, and professional service at the other.

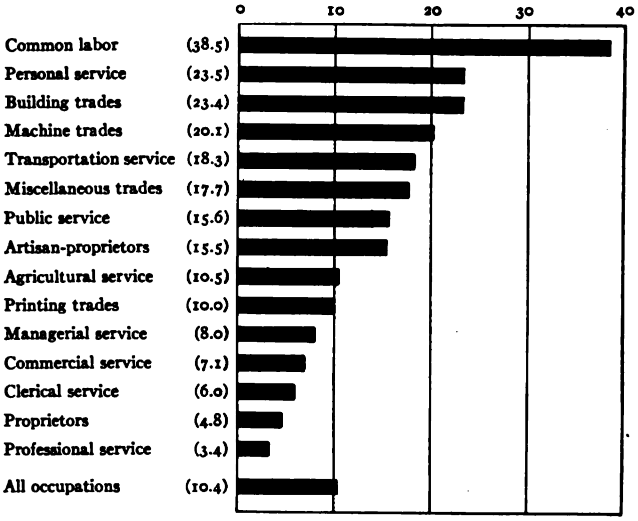

FIG. 15.—Showing the percentage of boys from each occupational group pursuing the two- and one-year vocational courses. St. Louis high schools (white).

Before leaving the returns from St. Louis it will be worth while to examine with some care the social composition of the boys and girls to be found in two of the curricula registering but few students—the classical and fine arts courses. The first is distinctly reminiscent of the time when secondary education was avowedly selective in its character; and the second is one of the newer courses which is supposed to rest on the possession of some special talent or is regarded as a preparation for a life of leisure. The occupations of the fathers of the students (boys and girls combined) pursuing these two curricula are given in percentages in Table XXIII. Apparently the prestige of the classical course carries but little weight with the laboring classes. Note, on the other hand, the extraordinarily disproportionate representation of the professionals. Almost one-third of these students come from this group which constitutes less than 9 per cent of the total high-school population. The fine arts course also is not a course for the children of labor, as is clearly seen. To what extent this is due to lack of talent is an unanswered question. But it is probable that the explanation is to be found in neither the presence nor the absence of talent, but in circumstance.

TABLE XXIII

Percentage Distribution of the Occupations of the Fathers of 67 Students Pursuing the Classical Course and 189 the Fine Arts Course in the St. Louis High Schools, All Classes

Parental Occupation	Classical Course	Fine Arts Course
Proprietors	15.0	29.1
Professional service	31.3	11.6
Managerial service	17.9	22.2
Commercial service	8.9	12.2
Clerical service	11.9	5.8
Agricultural service		1.1
Artisan-proprietors	1.5	4.7
Building trades	4.5	1.6
Machine trades	3.0	3.7
Printing trades	1.5	.5
Miscellaneous trades		1.1
Transportation service		2.1
Public service	3.0	1.1
Personal service		1.1
Miners, lumber-workers, fishermen		
Common labor		
Unknown	1.5	2.1
Total	100.0	100.0

SEATTLE

In the high schools of Seattle there are seven curricula, of which six are open to the girls and six to the boys, although practically no boys are found in one of them. They are all four-year courses with the opportunity for electives ranging all the way from seven to eighteen credits[1] out of a total of thirty-two. In addition to a uniform requirement for all courses of six credits in English and two credits in United States History and Civics, the seven curricula may be described as follows:

I. *The academic course* emphasizes the traditional academic subjects and points toward the higher education, although each of the curricula offered may prepare for college, if the student exercises a little prudence in the choice of electives, because of the latitude in the entrance requirements among the colleges of the West. This course includes five credits in mathematics, two in science, two in history besides the common requirement, four in one foreign language, and eleven electives.

II. *The general course* is designed for those students who are not definitely decided on their educational future. Over one-half of the required number of credits are elective. The prescribed subjects are two credits in algebra, two in history, two in laboratory science, and eighteen electives.

III. *The commercial course* prepares for clerical positions and includes seventeen credits in the ordinary commercial subjects, allowing but seven elective credits.

IV. *The industrial arts course* is really not so industrial as it sounds. But six credits in shopwork and mechanical drawing are required. The remainder of the course is composed of mathematics, history, laboratory science, and eleven elective credits.

V. *The home economics course* includes two credits in mathematics; two in chemistry; six in food, clothing, and design; two in household management; and twelve electives.

VI. *The art and crafts course* makes but a narrow appeal, although it does provide opportunity for the election of twelve credits. It prescribes two credits in mathematics, two in laboratory science, and eight in art or craft.

VII. *The music course* likewise attracts but few students. It is composed of two credits in mathematics, two in history, four in foreign languages, two in science, six in music, and eight electives.

The facts pertaining to the selection of curricula are presented in Table XXIV. The academic course is seen to be the most popular among both girls and boys. The number taking the art and crafts and fine arts courses is very small, almost negligible. A comparison with Bridgeport and St. Louis shows the commercial course to attract a much larger proportion of the girls in the East than in the West. Thus in

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[1] A credit here means a semester's work in a particular subject.

Bridgeport 50.2 per cent of all the girls in the high school are enrolled in this course; while in St. Louis this percentage drops to 40.8; and in Seattle it drops still farther to 26.1. It is possible that this difference may be explained in terms of reduced expectations of college attendance on the part of girls in the East due to the practical absence of the great co-educational state universities common in the West.

TABLE XXIV

SELECTION OF CURRICULA BY CHILDREN FROM THE VARIOUS OCCUPATIONAL GROUPS IN THE SEATTLE HIGH SCHOOLS, ALL CLASSES

Parental Occupation	Girls							Boys					
	Academic	General	Commercial	Home Economics	Art and Crafts	Music	Total	Academic	General	Commercial	Industrial Arts	Art and Crafts	Total
Proprietors	251	131	111	29	20	1	543	297	151	40	36	2	526
Professional service	224	84	36	18	19	4	385	187	77	20	34	.....	318
Managerial service	226	151	135	53	25	2	592	227	144	40	48	1	460
Commercial service	140	77	44	23	10	1	295	128	64	23	23	1	239
Clerical service	54	51	43	18	6	1	173	56	32	10	10	.....	108
Agricultural service	53	36	43	18	7	.....	157	63	48	14	11	.....	136
Artisan-proprietors	20	22	39	6	3	1	91	23	24	8	11	1	67
Building trades	83	114	102	34	19	3	415	89	112	46	59	3	309
Machine trades	60	68	94	26	10	3	261	67	65	12	44	3	191
Printing trades	14	15	6	1	1	.....	37	12	10	2	4	.....	28
Miscellaneous trades	23	21	24	8	1	.....	77	19	17	6	2	.....	44
Transportation service	59	30	84	22	5	1	201	62	54	15	14	.....	145
Public service	8	15	27	6	1	1	58	11	13	8	3	.....	35
Personal service	13	25	16	10	.....	.....	64	10	10	8	7	.....	35
Miners, lumber-workers, fishermen	8	17	14	4	.....	.....	43	3	6	4	4	.....	17
Common labor	9	20	17	5	.....	.....	51	10	19	7	1	.....	37
Unknown	37	42	38	12	.....	.....	129	49	45	12	13	1	120
Total	1,282	919	933	203	127	18	3,572	1,313	891	275	324	12	2,815

As in the other cities studied, the girls from the different occupational groups in the Seattle high schools exhibit characteristic tendencies in the choice of curricula. This is brought out best in Table XXV, in which the probable distribution of one hundred girls from each of the groups over the six courses offered is given. The arrangment of the table is based on the proportion to be found in the academic course. There is seen to be a distinct negative correlation between choice of the academic and choice of the commercial course. For example, fifty-eight out of every hundred of the girls whose fathers are engaged in the professional pursuits are registered in the former course, while but nine are taking the latter. On the other hand, among the daughters of public servants, chiefly policemen and city firemen, but fourteen out of a hundred are to be found in the former and forty-six in the latter course. On the whole, the non-labor groups incline toward the academic and the labor groups toward the commercial course. The other courses appear to be almost equally attractive to both of these groups, although there is perhaps some slight observable disposition on the part of the girls whose fathers are engaged in manual labor to choose the general course in disproportionate numbers. This, in all probability, is due to greater uncertainty about the future on the part of these students. It is interesting to note here, as in St. Louis, the failure of the home economics course to make any large appeal to the daughters of laborers. It seems that, for various reasons, these girls are interested primarily in courses that relate rather definitely to wage-earning.

TABLE XXV

PROBABLE DISTRIBUTION OF 100 GIRLS FROM EACH OCCUPATIONAL GROUP OVER THE SIX COURSES OPEN TO GIRLS IN THE SEATTLE HIGH SCHOOLS, ALL CLASSES

Parental Occupation	Academic Course	General Course	Commercial Course	Home Economics Course	Art and Crafts Course	Music Course	Total
Professional service	58	22	9	5	5	1	100
Commercial service	48	26	15	8	3	....	100
Proprietors	46	24	21	5	4	....	100
Managerial service	38	26	23	9	4	....	100
Printing trades	37	41	17	3	2	....	100
Agricultural service	34	23	27	12	4	....	100
Clerical service	31	30	25	11	3	....	100
Miscellaneous trades	30	27	31	11	1	....	100
Transportation service	29	15	42	11	3	....	100
Machine trades	23	26	36	10	4	1	100
Artisan-proprietors	22	24	43	7	3	1	100
Personal service	20	39	25	16	....	....	100
Buildings trades	20	27	39	8	5	1	100
Miners, lumber-workers, fishermen	19	40	33	8	....	....	100
Common labor	18	39	33	10	....	....	100
Public service	14	26	46	10	2	2	100
All occupations	36	26	26	8	4	....	100

Table XXVI, showing the probable distribution of one hundred boys from each occupational group over the five curricula open to boys, is arranged on the same principle as the table immediately previous giving similar facts for the girls. The two curricula to be contrasted here are the academic and general courses. The first draws especially from the non-labor groups, with professional service leading, while the students choosing the second come in larger proportion from the labor groups. The contrast is not so pronounced as among the girls, but it is sufficiently marked to be significant. It is surprising, perhaps, that there are no clear tendencies shown in the choice of the two vocational curricula—the industrial arts and commerical courses. It is true that certain of the labor groups are much better represented in these curricula than any of the non-labor groups. On the other hand, some of the labor groups have very poor representation. It should be borne in mind, however, that none of these Seattle curricula points exclusively toward industry or commerce and away from college.

TABLE XXVI

PROBABLE DISTRIBUTION OF 100 BOYS FROM EACH OCCUPATIONAL GROUP OVER THE FIVE CURRICULA OPEN TO BOYS IN THE SEATTLE HIGH SCHOOLS, ALL CLASSES

Parental Occupation	Academic Course	General Course	Industrial Arts Course	Commercial Course	Art and Crafts Course	Total
Professional service	59	24	11	6	....	100
Proprietors	57	29	7	7	....	100
Commercial service	53	27	10	10	....	100
Clerical service	52	30	9	9	....	100
Managerial service	49	31	11	9	....	100
Agricultural service	47	35	8	10	....	100
Miscellaneous trades	43	39	4	14	....	100
Printing trades	43	36	14	7	....	100
Transportation service	43	37	10	10	....	100
Machine trades	35	34	23	6	2	100
Artisan-proprietors	34	36	16	12	2	100
Public service	31	37	9	23	....	100
Building trades	29	36	19	15	1	100
Personal service	29	29	20	22	....	100
Common labor	27	51	3	19	....	100
Miners, lumber-workers, fishermen	17	35	24	24	....	100
All occupations	47	32	11	10	....	100

CONCLUSION

Certain conclusions stand out very clearly in the light of this analysis of practice in the several cities studied. The children coming into the public high school from the different occupational groups exhibit different tendencies in their election of curricula. Those occupations that have relatively poor representation in the high school patronize the "practical" courses, the courses which point outward toward wage-earning rather than upward toward higher education. The lower the grade of occupation, the stronger this tendency manifests itself. The girls are apparently influenced in larger measure than the boys by the occupational status of the parent.

CHAPTER IX

PARENTAL OCCUPATION AND EXPECTATIONS FOLLOWING GRADUATION

Closely related to a student's choice of curricula are his expectations following graduation, since presumably the various curricula are organized around different objectives. This relation, however, is not always sustained in individual cases. Many instances can be found of students pursuing the college preparatory curricula who do not expect to attend college. And one would not have to seek far to find children enrolled in the commercial course who are not planning to enter into clerical work. Consequently it will be of interest to make a study of the relation between parental occupation and expectations following graduation from high school as a supplement to the material presented in the immediately previous chapter.

In each of the four cities studied this question was asked of each student: "What do you intend to do following graduation from high school?" There were, of course, a few students in each high school who reported that they did not intend to complete the course. In tabulating the data their intentions on leaving the high school were accepted in lieu of the usual statement of expectations following graduation.

But of what value are the responses to this question? May they be regarded as possessing any measure of truth? Certainly, as indices of what these students are actually going to do after graduation, they are far from satisfactory. In considering their future prospects, these young people in all probability err on the side of optimism, as most people would. Many of those who, in their Freshman year, speak with some confidence of their intentions to attend college or university after graduation from high school will never complete the high-school course, let alone grace the halls of an institution of higher learning. On the other hand, there will probably be some whose plans to attend college will crystallize only toward the end of their stay in the secondary school. It is not maintained, therefore, that these responses have a great deal of objective validity; but it is believed that group-differences, to the degree they are revealed here, have significance. It seems likely that the optimistic bias would be exhibited equally by the various groups, or at least that the bias, in so far as it exists in varying measure among the groups, would tend to minimize rather than exaggerate the differences that actually exist.

Since the expectations of the two sexes following graduation are somewhat different, the presentation divides itself into two parts, the one dealing with the girls, and the other with the boys. The order of treatment will be as just indicated.

EXPECTATIONS OF THE GIRLS

For purposes of tabulation, the various activities into which the girls expect to go are classified under twelve headings, namely, college or university, normal school, business college, other school, professional service, clerical service, commercial service, industrial service, home, travel, work, and undecided. The meaning of each of these is clear with the possible exception of the eleventh, *work*. In some cases the response was the very general statement that the student intended to go to work after leaving the high school. The kind of work was not specified. Cases of this type are included under this category.

The gross data for the four cities are given in Table XXVII. According to this table, the largest group, 36.5 per cent of the entire number, are intending to go to college. Over 13 per cent are going to normal school, business college, or other higher schools. Of those who do not plan to continue their education, by far the largest number, practically one-fourth of the total, are going into the clerical occupations. About 5 per cent will engage in professional service, chiefly nursing and teaching. Very few are looking toward either the commercial or industrial occupations. Practically none are looking forward to travel. Perhaps the most interesting fact in the table is the number expecting to remain at home. Only 82 of the 9,286 girls reporting have their eyes on the domestic life, according to their own statements. Of course these returns should not be taken too seriously, since at this particular point the question about expectations is a rather personal one. Although there were a few girls who state very frankly that they expect to "get married," the ordinary high-school girl has a natural reluctance about exhibiting too much certainty about a very uncertain matter. Nevertheless, it is apparent that the great majority of the girls of this generation are looking forward to an active life in the world of affairs after leaving the high school. Apparently they are not so domestic as were their mothers and grandmothers. In addition to these statements of specific expectations, a small group merely report that they are going to work, and 14.4 per cent are undecided. In conclusion, the general observation may be made that in these high schools the attention of the girl students is rather strongly directed toward a continued education, and especially toward the college.

TABLE XXVII

EXPECTATIONS FOLLOWING GRADUATION OF 9,286 GIRLS IN THE HIGH SCHOOLS OF BRIDGEPORT, MT. VERNON, ST. LOUIS, AND SEATTLE

Expectations Following Graduation	Bridgeport	Mt. Vernon	St. Louis	Seattle	Total	Percentage
College	241	186	1,340	1,624	3,391	36.5
Normal school	294	4	146	81	525	5.7
Business college	16	49	166	247	478	5.1
Other school	25	34	63	101	223	2.4
Professional service	39	25	197	217	478	5.1
Commercial service	....	6	10	....	16	.2
Clerical service	443	136	1,208	522	2,309	24.9
Industrial service	2	....	21	12	35	.4
Home	1	4	64	13	82	.9
Travel	....	....	3	5	8	.1
Work	27	2	171	201	401	4.3
Undecided	132	70	589	549	1,340	14.4
Total	1,220	516	3,978	3,572	9,286	100.0

If the returns from the various cities are examined and compared, some interesting differences are noted. Bridgeport and Seattle represent the two extremes. In the former but 19.4 per cent of the girls are intending to go to college as compared with 45.5 per cent in the latter. The other side of this comparison is found in the proportion expecting to enter the clerical occupations. In Bridgeport this proportion mounts to 36.3 per cent, while in Seattle it falls to but 14.6 per cent. These differences are probably to be explained in terms of population and geography. As contrasted with Seattle, the population of Bridgeport is predominantly industrial and largely of the new immigration. Also the tradition of a higher education for women is not so strong in the East as in the West. The presence of a great state university, the University of Washington, is another important factor in explaining the strong college tendency among the girls of the Seattle high schools.

The table also shows considerable variation in the proportion of students looking toward the normal school. In Bridgeport 24 per cent of the girls are planning to attend teacher-training institutions. In Mt. Vernon, on the other hand, this proportion falls to .8 per cent; and in Seattle and St. Louis it is but 2.3 and 3.7 per cents respectively.

This large number in Bridgeport intending to enter the normal school probably explains in some measure the small proportion planning to enter college. The presence of a city normal school in Bridgeport is an important factor in accounting for this situation, although the Harris Teachers' College of St. Louis does not seem to have a similar effect there. Another matter worthy of comment in this connection is the small number of students outside of Bridgeport thinking about entering teacher-training institutions. Clearly these cities are not producing their own future teachers.

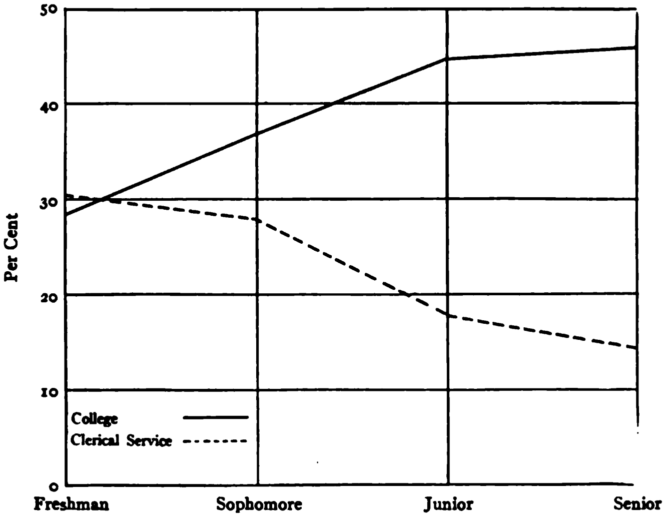

FIG. 16.—Showing the percentage of girl students in each of the high-school years intending either to go to college or to enter clerical service following graduation. Data from 9,286 girls in the high schools of Bridgeport, Mt. Vernon, St. Louis, and Seattle.

The characteristic differences in the intentions exhibited by the students in the four years of the high school are shown graphically in Figure 16 in which the percentage of girls in each year expecting to go to college is compared with the corresponding percentage for those planning to enter the clerical occupations. The proportion looking toward the college begins at 28.5 per cent in the Freshman year and rises to 45.8 per cent in the Senior year. The clerical service shows just the reverse tendency. In the first year of the high school there are actually more girls expecting to engage in clerical work on leaving high school than there are preparing for college, 30.4 as against 28.5 per cent, to be exact.

This proportion, however, falls rapidly, as the other rises, and in the last year of the high school it is reduced to 14.3 per cent. This is an excellent exhibition of the strength of the college-preparatory tradition in the public high school. It is to be explained in terms of both elimination and adaptation.

We come now to the more important part of the study—that pertaining to the parental occupation. A detailed table showing the complete distribution of the girls from each occupational group will not be given, since it would contribute nothing of consequence that cannot be presented in a more simplified form. The percentage of students intending to pursue each of the three more important lines of activity is presented for each set of occupations in Table XXVIII. It shows that 49.4 per cent of the girls whose fathers or guardians are occupied as proprietors are expecting to attend college, 4.5 per cent to go to normal school, and 12.0 per cent to enter the clerical service following graduation from high school. The remaining 34.1 per cent, not included in this table, are distributed over the other nine activities. Tremendous differences among the occupational groups are observed. The percentage intending to go to college ranges all the way from 61.8 for professional service to 13.5 for the miscellaneous trades. In the main, the labor groups are

TABLE XXVIII

PERCENTAGE OF GIRLS FROM EACH OCCUPATIONAL GROUP INTENDING TO GO TO COLLEGE, ENTER NORMAL SCHOOL, OR ENGAGE IN CLERICAL WORK ON LEAVING HIGH SCHOOL. DATA FROM 9,286 STUDENTS IN BRIDGEPORT, MT. VERNON, ST. LOUIS, AND SEATTLE

Parental Occupation	College	Normal School	Clerical Service
Proprietors	49.4	4.5	12.0
Professional service	61.8	4.0	7.7
Managerial service	41.1	6.1	19.9
Commercial service	47.1	3.4	17.3
Clerical service	33.3	6.0	27.4
Agricultural service	33.6	7.1	21.8
Artisan-proprietors	23.9	6.1	36.9
Building trades	17.3	5.4	35.7
Machine trades	19.0	8.9	40.3
Printing trades	33.0	....	26.0
Miscellaneous trades	13.5	8.7	45.9
Transportation service	23.1	6.2	30.8
Public service	21.3	9.8	32.3
Personal service	18.6	6.4	37.1
Miners, lumber-workers, fishermen	25.5	....	29.8
Common labor	14.6	4.3	50.0
All occupations	36.5	5.7	24.9

low and the non-labor groups high in the frequency of college expectations. The reverse is true with respect to the proportion planning to enter the clerical occupations. Note the range from 7.7 per cent for professional service to 50.0 per cent for common labor. The normal school apparently is attracting the attention of students from the various occupations impartially. In no single group do we find any marked tendency toward teacher-training institutions.

Special attention is directed in Table XXIX to the composition of that group of girls in the high school who are intending to go to college.

TABLE XXIX

Percentage Distribution of the Occupations of the Fathers or Guardians of 3,391 Girls in All Four High-School Years and of 688 Girls in the Senior Year Who Are Intending to Go to College. Bridgeport, Mt. Vernon, St. Louis, and Seattle

Parental Occupation	All Four Years	Senior Year
Proprietors	24.6	24.4
Professional service	15.6	17.7
Managerial service	19.0	20.3
Commercial service	11.8	12.2
Clerical service	5.7	5.4
Agricultural service	2.4	2.1
Artisan-proprietors	2.7	2.6
Building trades	3.7	3.3
Machine trades	3.8	2.9
Printing trades	1.0	.6
Miscellaneous trades	1.4	1.2
Transportation service	3.3	2.6
Public service	1.0	.3
Personal service	.8	1.0
Miners, lumber-workers, fishermen	.3	.3
Common labor	.5	.3
Unknown	2.4	2.8
Total	100.0	100.0

One-half of the table gives in percentages the occupations of the fathers or guardians of the entire number of girls in all four years of the high school who are looking toward college; the other gives similar data for this particular group in the Senior year. It will be seen at once that these girls come from a very restricted section of the population. Five occupational groups (proprietors, professional service, managerial service, commercial service, and clerical service) include 76.7 per cent of all the girls expecting to enter college. In an earlier chapter it was observed that these five groups accounted for but 71.5 per cent of all the students in the Senior year. Thus the group of girls going to college, enrolled in all four years, shows a considerably higher degree of selection than the complete registration of the Senior year. Relatively speaking, the daughters of the laboring classes do not look forward to the higher education.

Furthermore, the second half of this table makes it clear that this selection continues to operate from year to year with the result that exactly 80 per cent of the girls in the last year of the high school who are planning to go to college come from the five groups just named. These facts are presented graphically in Figure 17. If the artisan-proprietors and agricultural service be set aside as not strictly labor groups, the contribution of the laboring classes is reduced to but 12.5 per cent, and it seems altogether probable in the light of evidence already presented that this representation of labor will be further reduced when the roll is called in the Freshman year of college. These statements on the part of high-school Seniors are in some cases certainly no more than expressions of desire which will have to give way before the facts of life.

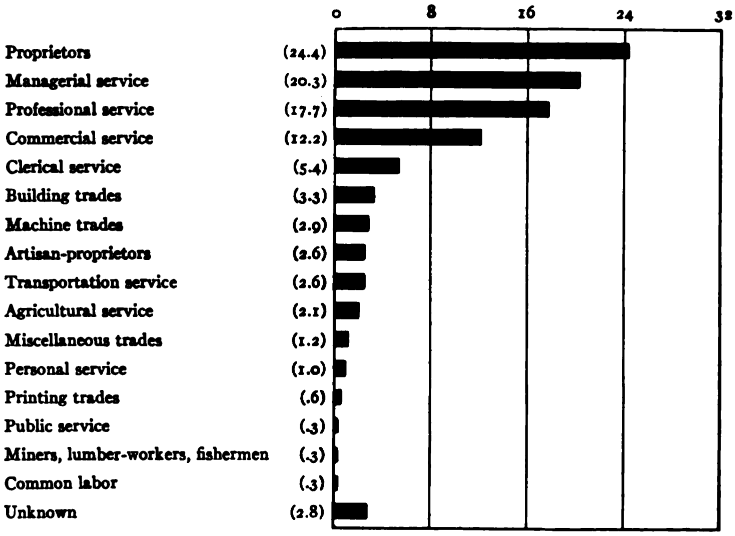

FIG. 17.—Showing by percentages the occupations of the fathers or guardians of 688 girls in the Senior year of the high school who are intending to go to college. Bridgeport, Mt. Vernon, St. Louis, and Seattle.

One other relation should be examined before passing to an analysis of the expectations of the high-school boys. It is the relation between the occupational groups in the different years of the high school. And for purposes of economy a comparison will be made between but two of the groups, the professional service and the machine trades. The former represents the tendency among the non-labor, while the latter is typical of the labor groups. The comparison is drawn in Figure 18. In the Freshman year the widest differences are noted. Here 58.5 per cent of the girls from professional homes are intending to go to college. All the forces of home and tradition are pointing them in that direction. It is a question that is settled for them. They do not have to think about it. On the other hand, of the girls in this first year whose fathers are engaged in the machine trades, only 13.7 per cent are looking toward the college. As we pass up through the years, we see the proportion going to college increasing for each group, until in the Senior year, the percentage is 67.8 for the one, and 29.0 for the other. The increase for the machine trades is the larger. This is, in all probability, to be explained through the strong college-preparatory tradition which the student encounters in the high school, as well as through greater elimination among those not intending to go on to college.

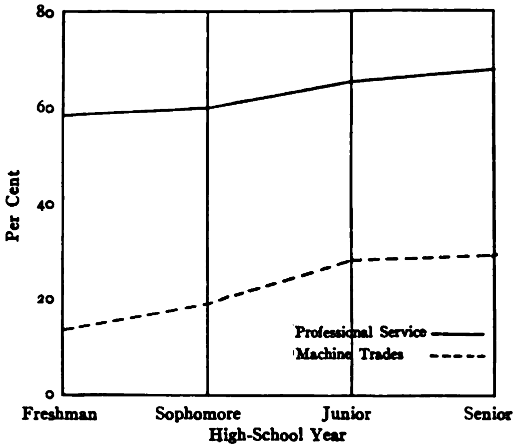

FIG. 18.—Showing for each of two occupational groups the percentage of girls in each year of the high school intending to go to college. Bridgeport, Mt. Vernon, St. Louis, and Seattle.

EXPECTATIONS OF THE BOYS

Naturally the classification of activities for the boys, though fundamentally the same as that used for the girls, has its characteristic features. "Normal school" and "home" are eliminated, and in addition to the remaining categories of the previous classification, "agriculture," "transportation service," and "public service" are included. Under these thirteen headings it was found possible to group the expectations of all the boys.

TABLE XXX

EXPECTATIONS FOLLOWING GRADUATION OF 7,979 BOYS IN THE HIGH SCHOOLS OF BRIDGEPORT, MT. VERNON, ST. LOUIS, AND SEATTLE

Expectations Following Graduation	Bridgeport	Mt. Vernon	St. Louis	Seattle	Total	Percentage
College	655	340	1,822	1,796	4,613	57.8
Business college	9	6	17	27	59	.8
Other school	40	15	80	59	194	2.4
Professional service	11	7	37	24	79	1.0
Commercial service	32	27	114	89	262	3.3
Clerical service	33	46	196	44	319	4.0
Industrial service	33	29	92	101	255	3.2
Transportation service	....	....	11	5	16	.2
Public service	2	....	3	8	13	.2
Agriculture	1	....	13	12	26	.3
Travel	....	....	2	7	9	.1
Work	47	27	598	168	840	10.5
Undecided	174	71	574	475	1,294	16.2
Total	1,037	568	3,559	2,815	7,979	100.0

Table XXX shows the college tradition to be much stronger among the boys in these four cities than among the girls. Of all the boys in high school, 57.8 per cent are intending to go to college, according to their own statements. No other line of activity is attracting a sufficiently large number to be worthy of comment. Slightly over 16 per cent are "undecided" and 10.5 per cent are just going to "work," but these categories are so general as to make it unnecessary to qualify the preceding statement.

An examination of the facts for the different cities shows no such variation here as was found for the girls. In each city over one-half of the boys are looking toward the college. If Bridgeport and Seattle are compared, it is discovered that the percentages of such boys in the high schools of the two cities are almost identical, being 63.2 and 63.8 respectively. It will be remembered that the corresponding percentages for the girls were 19.4 and 45.5. These figures are illustrative of a tendency noted at several points in this study, namely, that the girls appear to represent the social class from which they come more than do the boys. The industrial and immigrant character of the Bridgeport population provides little stimulus toward a college education. The boys break over, the girls conform.

These differences between the boys and the girls are brought out more clearly in Figure 19. From the first year to the last over 20 per cent more boys than girls are expecting to enter college. This does not, of course, mean that all these boys will eventually go to college, but it does indicate that they regard college preparation as a very good explanation of their registration in the high school. So far as the boys are concerned, it seems that the public high school is predominantly a college-preparatory institution in spirit, in spite of all the concessions made to the practical needs of those whose education must end with the high school. This is not so true of the girls, because there is one curriculum in the high school which is very popular among them and which does point quite definitely to something besides the college—and that is the commercial course. Nothing comparable to it for the boys is to be found in the ordinary high school.

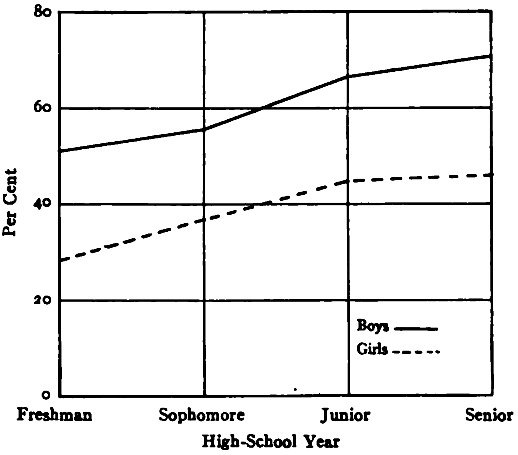

FIG. 19.—Showing the percentage of girls and the percentage of boys in each year of the high school intending to go to college. Bridgeport, Mt. Vernon, St. Louis, and Seattle.

Passing to a consideration of the relation between parental occupation and expectations following graduation, we shall merely call attention to the proportion from each group expecting to go to college. An examination of the detailed distribution is of little significance. These facts are given in Table XXXI. A minute exposition of this table is unnecessary, since the results are much the same as those already discussed for the girls. This difference alone should be noted, that the boys from the laboring classes exhibit a relatively stronger college tendency than do the girls. There is slight tendency for them to follow in the footsteps of their fathers. Most of them look on the high school as a means of lifting themselves out of the class into which they were born.

TABLE XXXI

NUMBER AND PERCENTAGE OF BOYS FROM EACH OCCUPATIONAL GROUP INTENDING TO GO TO COLLEGE AFTER GRADUATION FROM HIGH SCHOOL IN BRIDGEPORT, MT. VERNON, ST. LOUIS, AND SEATTLE, ALL CLASSES

Parental Occupation	Number	Percentage
Proprietors	1,152	66.4
Professional service	599	77.3
Managerial service	815	63.9
Commercial service	507	64.6
Clerical service	229	55.4
Agricultural service	106	59.6
Artisan-proprietors	163	47.1
Building trades	241	40.8
Machine trades	264	47.6
Printing trades	35	40.7
Miscellaneous trades	116	38.8
Transportation service	168	46.0
Public service	38	35.8
Personal service	39	39.8
Miners, lumber-workers, fishermen	3	15.8
Common labor	25	25.8
Unknown	113	44.3
Total	4,613	57.8

That there are, after all, important differences among the groups is shown in Figure 20, which presents for the boys the same comparison made for the girls in Figure 18. The percentages from both the professional service and the machine trades, in each year of the high school intending to go to college, are given. Large differences exist, but not so large as for the girls.

STUDENTS NOT EXPECTING TO COMPLETE THE HIGH-SCHOOL COURSE

As intimated at the beginning of this chapter, a few students were found who did not expect to complete the high-school course. It will be of interest to see from what elements in the population they come. Since the number in the three upper years is practically negligible, we shall confine our attention to the Freshman year.

Of the 6,782 students in the first year of the high schools in the four cities, only 451 expressed any doubt about their prospects of completing the course. Undoubtedly, many others were uncertain about the matter but failed to give expression to this uncertainty. The social composition of this group of children is given in Table XXXII. The first part of the table presents the actual distribution of the 451 students over the several occupational groups; the second, the percentage of the children from each of the groups who do not expect to complete the course. For purposes of comparison, this latter part of the table is the more significant. In the main, it shows the order already familiar to the reader. The children whose fathers are engaged in the professional occupations exhibit the least uncertainty about their stay in the high school. Only 3.3 per cent of them do not expect to complete the course. The children of common laborers, on the other hand, show the greatest uncertainty. Exactly 20 per cent, or one in every five, are doubtful about remaining until graduation. The other groups fall in between these two extremes, with the laboring classes occupying the less favorable positions. Because of the small number of cases involved in some of the groups, too much

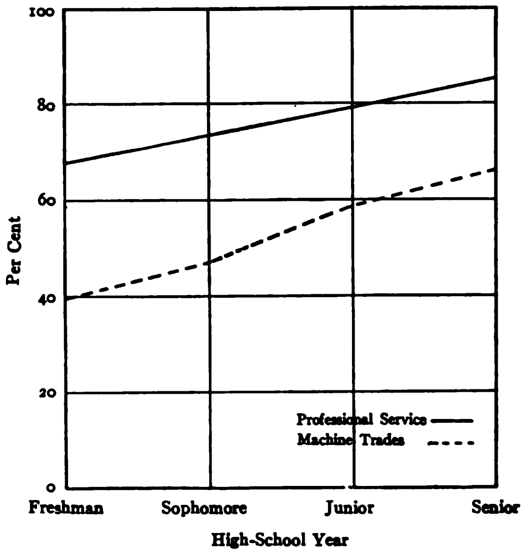

FIG. 20.—Showing for each of two occupational groups the percentage of boys in each year of the high school intending to go to college. Bridgeport, Mt. Vernon. St. Louis, and Seattle.

weight should not be attached to their records. The unfavorable showing of the printing trades, for example, is probably to be explained in this way. Likewise, the relatively favorable position of personal service would probably not be maintained in the face of more adequate data. On the whole, the evidence here supports the conclusions derived from the study of expectations following graduation.

TABLE XXXII

OCCUPATIONS OF THE FATHERS OR GUARDIANS OF 451 STUDENTS IN THE FIRST YEAR OF THE HIGH SCHOOL WHO DO NOT EXPECT TO COMPLETE THE COURSE, AND THE PERCENTAGE FROM EACH OCCUPATIONAL GROUP NOT EXPECTING TO COMPLETE THE COURSE. DATA FROM 6,782 FRESHMEN IN THE HIGH SCHOOLS OF BRIDGEPORT, MT. VERNON, ST. LOUIS, AND SEATTLE

Parental Occupation	Number	Percentage
Proprietors	43	3.6
Professional service	17	3.3
Managerial service	48	4.6
Commercial service	22	3.8
Clerical service	24	6.0
Agricultural service	17	10.5
Artisan-proprietors	14	4.7
Building trades	78	13.0
Machine trades	35	6.2
Printing trades	9	13.0
Miscellaneous trades	26	8.0
Transportation service	38	9.0
Public service	13	11.1
Personal service	6	6.3
Miners, lumber-workers, fishermen	5	16.1
Common labor	24	20.0
Unknown	32	13.3
All occupations	451	6.6

CHAPTER X

THE PUBLIC HIGH SCHOOL AND THE CULTURAL LEVEL

All that has been said in the previous chapters about parental occupations has a very direct bearing on the relation of the public high school to the various social and cultural levels within a community. All the evidence presented indicates that the high school is, in the main, serving the occupational groups representative of the upper social strata. This seems to be true even in those cities where the proportion of children of high-school age attending the public secondary school is relatively large. Of course, the writer is quite conscious of the fact that social lines do not follow rigidly the occupational divisions, but he is firmly convinced that, within limits, the occupation is an immensely important, if not a decisive, factor in determining social status. One does not canvass the ranks of manual labor while seeking out the select "Four Hundred" of urban society. To be sure, individuals occasionally break the bonds of an occupation without leaving it, but such cases are rare. Also, family connections and inheritance may set aside or shift the incidence of the decrees of occupation, as manifested in economic power, social prestige, and cultural advantages. These, however, are not the rule. Thus far, the study shows the high school drawing its population from the higher cultural levels.

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It is the purpose of this chapter to display an additional bit of evidence pointing in the same direction. In Bridgeport and Mt. Vernon, each high-school student was asked if there was a telephone in his home or the home in which he lived. This same question was asked the children in the compulsory continuation classes and the trade school in Bridgeport, as well as the pupils of the Mt. Vernon sixth grade. Returns on this item were not received from the students attending the Bridgeport Evening High School.

Obviously, the possession of a telephone is not an adequate index of cultural level. The resulting dichotomous classification of people makes of modern society an entirely too simple affair. It divides people into two hard and fast divisions—those who have telephones and those who have not. Clearly this is an over-simplification. It reminds us of the much-advertised classification of all men into two classes—the exploited and the exploiters. As useful as this may be for political purposes, and as true as it may be as a description of certain aspects of modern society, it does not give a truthful picture of people who, as a rule, are neither black nor white, but, on examination, are found to represent varying shades of gray.

Also, the possession of a telephone is not an infallible index of cultural level; some occupations demand a telephone in the home, others may require that it be absent. Undoubtedly, many persons do not have telephones in their homes who are living on a relatively high cultural plane and it is certain that the reverse is equally true. Yet, it must be admitted that the telephone is one of the many elements going to make up the cultured home. The correlation is not perfect, but it is positive.

An ideal investigation would have included returns on many other items, such as the number and character of books, magazines, and newspapers in the home, various other material possessions indicating comfort and taste, the character of the conversation, the interest in music and art, and a host of other things that are already in the reader's mind. But obviously, this ideal was not attainable in a study bounded by the ordinary limitations of investigation. A thorough investigation along lines here suggested of the cultural level and the standard of living of the homes from which high-school students come should make a valuable contribution toward the understanding of the problems which public secondary education is facing in this country.

The significance of the telephone, at least, as an index of general social and educational advancement, is shown in an impressive fashion in Figure 21. The data for this diagram are taken from the 1917 report of the Federal Census on Telephones, and *An Index Number for State School Systems*, by Ayres. The states, including the District of Columbia, were first arranged in order of their achievements in secondary education as measured by the percentage of the total school attendance credited to the high school in 1918. They were then grouped into five groups of ten states each, except the last, in which there are but nine. And finally, the number of telephones per thousand inhabitants was averaged for each of these groups of states. This figure forms the basis for the construction of the bars in the diagram.

It is clear that some relation between high-school attendance and the ratio of telephones to the population does exist. For the ten states ranking highest in the proportion of children attending high school, the average number of telephones per thousand inhabitants is 145, while the corresponding figure for the nine states ranking lowest in this respect is but 41. The relation, however, is not pronounced among the states at the upper end of this distribution. The first ten exceed the record of the second ten by two points only; and there is much overlapping between these two groups if the facts for individual states are examined. For the remainder of the distribution, on the other hand, there is relatively little overlapping, and the difference from group to group is marked. Of course, no claim is advanced that there is any large and direct causal relation between the number of telephones in a community and the attendance at high school. The one is certainly not the cause of the other. The installation of a telephone in a particular home will not, in some mysterious way, start the children of high-school age off to high school the following morning, if they have not been attending. It is much more likely that the two phenomena are both the effects of a common cause.

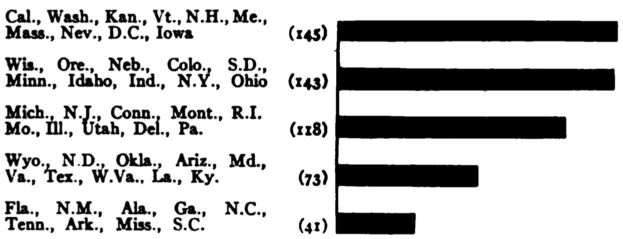

FIG. 21.—Showing the average number of telephones per 1,000 inhabitants in five groups of states in 1917,[1] arranged in order of the percentage that high-school attendance was of total public-school attendance in 1918.[2]

[1] *Bureau of the Census, Census of Electrical Industries*, 1917, "Telephones," p. 22.

[2] L. P. Ayres, *An Index Number for State School Systems*, p. 37.

BRIDGEPORT

In the city of Bridgeport there are 115 telephones for every thousand inhabitants. This is only a moderate record, since the number ranges in American cities from about 50 to 250. A more serviceable figure for the purposes of this study is the number of telephones in residences alone. On March 31, 1921, there were 8,302 such telephones. Assuming that the average family in Bridgeport consists of approximately five persons, there were probably about 30,000 families in the city at the time the data for this study were collected. In other words, telephones are to be found in about 28 per cent of the homes.

The percentage of children in the high school, the trade school, and the compulsory continuation classes, in whose homes there are telephones, is graphically presented in Figure 22. The children in the high school exhibit one extreme and those in the continuation classes the other; and the difference is indeed large. Among the former, telephones are in almost 50 per cent of the homes, while in the latter this percentage drops to approximately 7. The former is far above, and the latter far below the percentage for the entire city, as given above. The students in the trade school constitute an intermediate group, although here the percentage with telephones is somewhat smaller than for the population as a whole. Clearly the high-school population is a socially favored group as measured by this single criterion of culture.

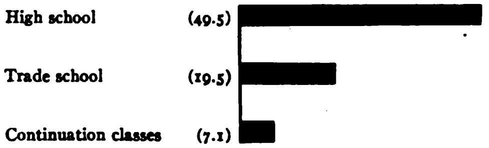

FIG. 22.—Showing the percentage of children in the high school, the trade school, and the compulsory continuation classes in whose homes there are telephones. Data from 2,531, from 198, and from 421 cases respectively. Bridgeport, February and March, 1921.

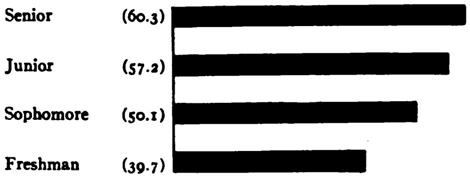

FIG. 23.—Showing the percentage of students in each year of the Bridgeport High School in whose homes there are telephones. March, 1921.

A study of the four high-school years reveals the continued operation of this selective tendency. An inspection of Figure 23 shows this to be true. Here is given the percentage of students in each of the years or grades in whose homes there are telephones. This advances from 39.7 per cent in the Freshman to 60.3 in the Senior year—an impressive advance. A word of caution, however, should be thrown out here in making an interpretation of the facts as presented. It seems probable that there are two influences working toward the same end. On the one hand, there is the selective factor. A disproportionately large number of those eliminated from high school come from homes in which there never have been and never will be telephones. On the other hand, the thought is worthy of consideration that continuation in high school may be a factor working for the installation of a telephone in the home. The social tone of the school and the associations formed probably cause these adolescents to bring pressure to bear on the parents favoring an expenditure for this purpose. There are many reasons why boys and girls of high-school age, particularly, should want telephones in their homes. Of course this factor operates outside, as well as inside, the high school, but the social life of the school conceivably accentuates it. At any rate, the difference from year to year is significant.

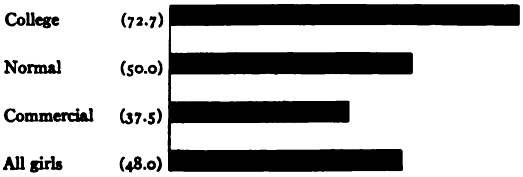

FIG. 24.—Showing the percentage of girls in each of three curricula in the Bridgeport High School in whose homes there are telephones. Data from 271, 376, and 715 cases respectively. March, 1921.

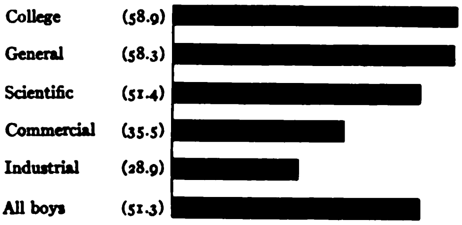

FIG. 25.—Showing the percentage of boys in each of five curricula in the Bridgeport High School in whose homes there are telephones. Data from 397, 562, 24, 141, and 45 cases respectively. March, 1921.

In view of the findings already discussed, bearing on the relation of parental occupation to choice of curricula, there is a natural expectation that the percentage of students coming from homes with telephones varies with the courses. And this is exactly the case, as shown in Figure 24 and Figure 25. In the former are presented the facts for the girls, and in the latter for the boys. The girls in the college course appear to be the most highly selected group. Almost three-fourths of these students have telephones in their homes. The boys in the same course show no such measure of selection, although for them, the percentage having telephones is larger than in any other group of boys. The difference found here between the two sexes confirms the conclusions drawn in an earlier chapter that class lines are more closely drawn among the girls than among the boys. At the other extreme, as might be expected, is the commercial course for the girls and the industrial arts course for the boys, with 37.5 per cent and 28.9 per cent respectively of the students pursuing the two courses having telephones in their homes. The boys in the commercial course have about the same record as the girls. The general course is somewhat above the average, the scientific course only slightly so. Likewise, the normal course seems to attract a constituency that is just about on a level with the high-school population as a whole with respect to this single item of information. All these facts constitute corroborative evidence of the socially selective character of the various curricula offered in the Bridgeport High School.

MT. VERNON

It has already been pointed out that the population of Mt. Vernon, since it is a suburb of New York City, is somewhat selective. In large measure, it is a middle-class residential community. Consequently, the ratio of telephones to the population is considerably higher than in Bridgeport and somewhat higher than in most American cities.

Since data from the sixth grade are available, the contribution of Mt. Vernon to this part of the study has peculiar interest. While it is admitted that the pupils of the sixth grade are the product of a certain measure of selection, they do give a fairly reliable cross-section of the population of the city. Figure 26 is based on the percentage of children in each grade, for which data are available, in whose homes there are telephones. This percentage in the sixth grade is 44, and rises to 87.5 in the last year of the high school. Although operating at a higher level, due to certain general differences between the two cities noted in the previous paragraph, the same tendencies appear here as in Bridgeport. From the sixth to the twelfth grade there is a constant increase in the proportion of children coming from homes having telephones. The curve rises somewhat more rapidly between the Freshman and Sophomore years of the high schools than in any other interval. Whether this is a chance feature of the curve that might disappear with data from a larger number of cases, or to be explained in terms of especially rapid elimination between the first and second high-school years, it is impossible to speak with assurance. Conceivably it might be accounted for through the operation of some other factor, such as the influence of high-school attendance on the installation of a telephone in the home. As a matter of fact, an examination of the enrolments in the different grades does indicate that the elimination between the Freshman and Sophomore years is somewhat more pronounced than in the grades from the sixth to the ninth. Whatever the explanation, the student in the Senior year of the Mt. Vernon high schools in whose home there is no telephone has a very small representation.

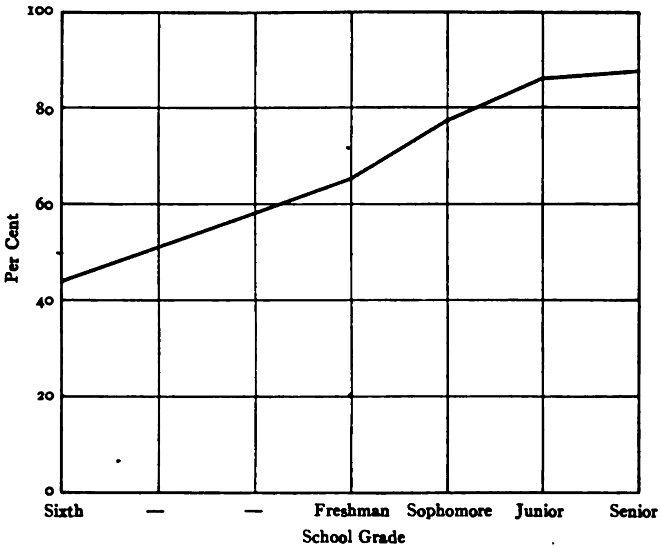

FIG. 26.—Showing for each grade from the sixth to the Senior year of the high school the percentage of children in whose homes there are telephones. No data for the seventh and eighth grades. Mt. Vernon, May, 1921.

TABLE XXXIII

PERCENTAGE OF STUDENTS PURSUING EACH CURRICULUM IN WHOSE HOMES THERE ARE TELEPHONES, MT. VERNON HIGH SCHOOLS, ALL YEARS

Curriculum	Girls	Boys	Total
Classical	92.2	86.9	89.5
General	77.6	82.5	79.8
Scientific	61.5	79.7	77.8
Commercial	57.3	52.7	55.7
Practical arts	....	34.9	34.1
All curricula	76.2	75.2	75.5

As in Bridgeport, there are interesting differences among the students choosing the various curricula. This is brought out clearly in Table XXXIII. The classical course, throughout the four high-school years, draws almost exclusively from students coming from homes where there are telephones. This tendency is somewhat more marked among the girls than among the boys. It seems that the girls from the well-to-do classes cling to the conventional course which carries with it the greatest social prestige. Note, in this connection, that in each case the two newer academic curricula (general and scientific) attract a somewhat smaller proportion of girls than boys from homes possessing telephones. The practical arts courses represent the other extreme, with the commercial course occupying an intermediate position. Telephones are found in the homes of only about one-third of the students pursuing the former curriculum. The fact that no girls in this course are from such homes should not be regarded seriously, since their number is very small.

CHAPTER XI

THE PUBLIC HIGH SCHOOL AND FAMILY INFLUENCES

In the American social order, large responsibilities respecting the care and education of the children are placed on the family. The measure of these responsibilities varies from place to place and it is not so great as in former times. The establishment of the public school and the passage of compulsory education laws have lightened the parental obligations and set limits to the parental authority in the domain of education. But, beyond the reach of these compulsory laws the family still holds its sway, and as a rule, the field of secondary education is in this realm. Consequently, it will be of interest to note the relation between certain family influences and the high-school population.

To a degree, all the sociological factors discussed in this monograph either determine or reflect home conditions. This is certainly true of parental occupation which is the backbone of the study. In this chapter, attention will be directed to certain of the narrower aspects of family life, including the mortality of parents, the occupation of the mother, the number of children, and the order of birth. This is not a particularly formidable array of family influences, nor is it at all complete. A much more detailed study is needed. Nevertheless, the study of these few factors will be seen to be significant and suggestive.

MORTALITY OF PARENTS

Perhaps there is no single incident in the life of the family that is more calamitous and disorganizing than the death of one of the parents before the children have reached maturity. This means that the natural balance between organ and function in the family is destroyed, and a readjustment involving, particularly, the status of the children is necessary before stability may again be secured. Of course, among the more fortunate economic classes, a storm of this sort may be weathered without undue sacrifice on the part of individual members, but these do not form a majority of the population. Again, some might maintain that divorce or separation is as serious a disintegrating factor as death itself, and much could be said in support of this view. But, except in cases of desertion, such occurrences are the fruitage of a longer or shorter process of growth, during which adjustments of various sorts may be contemplated and plans set in motion for their realization. However, regardless of the conclusion on this particular point, it is clear that the death of one of the parents is a serious matter.

Returns on this question were received from all the groups studied. The percentage of students in the high schools of the four cities having one or both parents deceased is given by sex and by city in Table XXXIV. According to this table, 12.9 per cent of the entire number of 17,265 students have one or both parents deceased. The mortality seems to be much higher among the fathers than among the mothers. This is distinctly true in each of the cities studied, and the data for the different high-school years show the same result. This is due to the greater age of the fathers and to the higher rate of mortality among men. Both parents are deceased in slightly over 1 per cent of the cases.

An examination of the facts from the different cities shows some variation. The percentage is lowest in Bridgeport and highest in Seattle, ranging from 12.3 in the former to 13.4 in the latter. The explanation apparently is to be found in the proportion of children of high-school age attending high school. The city maintaining a relatively large high-school enrolment is, other things being equal, likely to have in its high schools a larger proportion of children handicapped in various ways than the city with the smaller proportionate enrolment. Evidence bearing on this point will be presented in other parts of the chapter.

TABLE XXXIV

PERCENTAGE OF STUDENTS IN THE HIGH SCHOOLS OF BRIDGEPORT, MT. VERNON, ST. LOUIS, AND SEATTLE HAVING ONE OR BOTH PARENTS DECEASED. DATA FROM 17,265 CASES

PARENTAL MORTALITY	BRIDGEPORT			MT. VERNON			ST. LOUIS			SEATTLE			TOTAL		
	Girls	Boys	Both Sexes	Girls	Boys	Both Sexes	Girls	Boys	Both Sexes	Girls	Boys	Both Sexes	Girls	Boys	Both Sexes
Father deceased	7.6	4.9	6.4	7.4	8.8	8.1	7.8	7.5	7.6	8.1	7.0	7.8	7.8	7.3	7.5
Mother deceased	5.3	4.4	4.9	4.2	3.4	3.8	3.8	3.7	3.8	4.9	4.5	4.7	4.5	4.0	4.3
Both parents deceased	1.2	.8	1.0	1.2	1.2	1.2	1.6	.9	1.3	.8	.9	.9	1.2	.9	1.1
One or both deceased	14.1	10.1	12.3	12.8	13.4	13.1	13.2	12.1	12.7	13.8	12.9	13.4	13.5	12.2	12.9

The table also shows important differences between the sexes. The percentage of girls having one or both parents deceased is somewhat larger than the percentage of boys. This is true in each of the cities except Mt. Vernon, and is to be explained in the same way as the differences among the cities. In every city, except Mt. Vernon, the number of boys in high school is appreciably less than the number of girls. The boys are consequently a more highly selected group with the result that fewer of them are handicapped by the loss of a parent. Putting it in another way, from the standpoint of securing a secondary education, the death of a parent is a more serious matter to the boy than to the girl. Apparently the burden of earning the family livelihood is more likely to fall on the one than on the other.

A fundamental question should be raised here. Does the 12.9 per cent of children in high school who have lost one or both parents indicate that loss of a parent diminishes the educational opportunities of the child? What proportion of the children of high-school age have lost one or both parents by death? This is a rather difficult question to answer, although an answer may be approximated by using certain data furnished by the Federal Census. We know the average age of the high-school student and we know the average age of the parents of the student. Then assuming that the father was alive a year before the child was born, and taking from the United States Life Tables the mortality rates for the ages desired, it is an easy task to estimate the mortality of the parents of children of high-school age. The average age of high-school students is about sixteen years and the average ages of the fathers and mothers are approximately forty-eight and forty-three years respectively. Since all the fathers were alive seventeen years and all the mothers sixteen years before this census of high-school students was taken, it remains merely to compute the mortality rate for the seventeen- and sixteen-year periods respectively, beginning at thirty-one years for the fathers and twenty-seven for the mothers. In this way, after making certain slight additional computations, it is found that at least 24 per cent of children of high-school age have lost one or both parents by death. This is to be compared with the 12.9 per cent for high-school students. After making due allowance for the occasional student who reports a step-father or step-mother as an actual parent, and for the very rough method of calculation just used, the difference between these two percentages is altogether striking. There is apparently a strong relation between life or death of the parent and the educational opportunity of the child.

There is much corroborative evidence secured in this investigation that supports the conclusions of the previous paragraph derived from estimates and calculations. The change from year to year in the percentage of high-school students who have lost one or both parents is shown in Table XXXV. An examination of this table makes it clear that this percentage changes very little in passing from the Freshman to the Senior year. The difference of .4 per cent between these two years is too small to be of any significance whatsoever. Undoubtedly, during the three calendar years that separate the students in these two high-school grades, the parents of these students are not living under a condition of immunity from death. There is no good reason for believing that this unwelcome visitor passes over the homes of high-school students. Assuming then that the life tables apply to the parents of these children as to other folk, and assuming further that there is no selective elimination of those losing parents, the percentage of high-school students having one or both parents deceased should rise more than five points from the Freshman to the Senior year, or from 12.7 to at least 17.7.

TABLE XXXV

PERCENTAGE OF STUDENTS IN EACH YEAR OF THE HIGH SCHOOL HAVING ONE OR BOTH PARENTS DECEASED. DATA FROM 17,265 CASES IN BRIDGEPORT, MT. VERNON, ST. LOUIS, SEATTLE

High-School Year	Bridgeport	Mt. Vernon	St. Louis	Seattle	Total
Freshman....	10.7	14.8	12.4	13.4	12.7
Sophomore...	14.3	10.9	13.0	12.8	12.9
Junior.......	13.8	12.4	12.6	13.9	13.2
Senior.......	10.8	14.0	13.1	13.9	13.1
Total....	12.3	13.1	12.7	13.4	12.9

In Mt. Vernon, returns on this question of mortality of parents were secured from all children in the sixth grade. Again assuming no selective elimination, the percentage of children who have lost one or both parents should be considerably higher in the high school than in the sixth grade. But such is not the case. The percentage is actually more than two points lower in the former than in the latter, being 13.1 and 15.3 respectively. Reasoning from the life tables, the figure for the sixth grade approximates the expectation, although it is from 1 to 2 per cent lower. Instead of being lower for the Senior year of the high school than for the sixth grade, it should be seven or eight points higher. The evidence here, therefore, reflects very clearly the importance of the life of the parent in promoting school attendance.

The data from the various groups of children of high-school age are illuminating in this connection. In Figure 27 the group of 514 children of high-school age in Seattle is compared with the high-school population of the same city. Although the former are on the average slightly younger than the latter, 21.7 per cent of the children at work have lost one or both parents as against but 13.4 per cent of the high-school students.

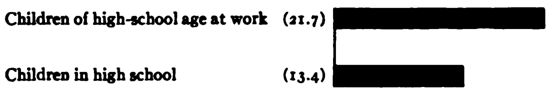

FIG. 27.—Showing percentage of children in each of two groups having one or both parents deceased. Data from 514 children of high-school age at work and 6,387 children in high school. Seattle, 1919–20.

The four groups from Bridgeport present an even more striking comparison. Examine Figure 28 in which the facts for the evening high school, the compulsory continuation classes, the state trade school, and the day high school are presented graphically. In interpreting this diagram it should be kept in mind that the students in the trade school are of about the same age as those in the regular high school, while those in the evening high school average a year and one-half older, and the children in the continuation classes are a half-year younger. With these considerations in mind, the comparisons made in this diagram take on significance. Practically one out of every three students in the evening high school has lost a parent. The mortality among the parents of this group is more than two and one-half times the mortality among the parents of high-school students. It should be greater by 3 or 4 per cent because of the age differences, but no more than that. Thinking in terms of ages, the percentage should be higher for the high school than for the continuation classes, but the reverse is true in actual fact, to the extent of more than 9 per cent. Because of its two-year course and its practical bent, the trade school enrols a larger proportion

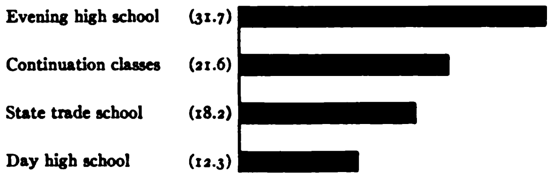

FIG. 28.—Showing percentage of children in each of four groups having one or both parents deceased. Bridgeport, 1920–21.

of children who have been unfortunate in this respect than does the high school.

One other bit of evidence bearing on this question is presented in Table XXXVI. In the previous chapter it was pointed out that between 6 and 7 per cent of the students in the Freshman class do not expect to complete the course, according to their own statements. In three of the cities, Bridgeport, Mt. Vernon, and St. Louis, the relation of this matter to mortality of parents was worked out for the first-year students, and the results are given in this table. It will be noted that there is a much larger percentage who have lost their parents among those who do not expect to complete the course than among the students of the entire Freshman class. To be exact, the percentages are 21.4 and 12.4 respectively. Furthermore, this tendency is decidedly more marked for the boys than for the girls. Thus, while in the general high-school population the girls show a higher proportion having deceased parents than the boys, in that part of the student body not expecting graduation the reverse is true. Both facts support the conclusion that disorganization of the family falls more heavily on the boy than on the girl.

TABLE XXXVI

PERCENTAGE OF STUDENTS IN EACH OF TWO GROUPS HAVING ONE OR BOTH PARENTS DECEASED. DATA FROM 4,437 STUDENTS IN THE FRESHMAN YEAR OF THE HIGH SCHOOL IN BRIDGEPORT, MT. VERNON, AND ST. LOUIS

Group	Girls	Boys	Both Sexes
Students in the Freshman class not expecting to complete the high-school course..	20.6	22.1	21.4
All students in the Freshman class........	12.8	11.9	12.4

OCCUPATION OF THE MOTHER

It is well known that in many American families the mother engages in remunerative labor outside the home and in this way contributes to the family support. It is clear that, from the standpoint of the home, this is a disintegrating influence, or, at least, is evidence of disintegration. In most cases the mother is forced to carry this extra burden because of economic pressure, and it therefore may be ordinarily regarded as an indication of poverty. It is apparent, however, that this is not true in all cases, for occasional reports in this study indicate that rare instances of the "emancipated" woman do appear. Some women with families are demanding and are getting the privilege of earning their own livings in their own ways.

Data were secured from the students in the high schools of all four cities showing the extent to which their mothers were contributing to the support of the family. Similar data were also obtained from all the non-high-school groups except the children of high-school age at work in Seattle. Two questions were asked each individual, the one checking the other. The returns are relatively complete and are thought to be accurate.

Of the 17,265 high-school students included in the study, 1,289 or 7.5 per cent reported their mothers to be engaged in remunerative employment of some kind outside the ordinary duties of the housewife. There is some variation from city to city. The highest percentage of 10.3 is found in Seattle. Then follows Bridgeport with 6.9, St. Louis with 5.6, and finally, Mt. Vernon with 5.4. These differences are to be explained in terms of the high-school enrolment and the occupational character of the population. For example, the large enrolment in the Seattle High School accounts for the high percentage of working mothers, since the deeper strata of the population are reached by the schools. Mt. Vernon, on the other hand, also has a relatively large proportion of its children in high school, but a low percentage of working mothers. This is probably due to the exceptional strength of the middle classes in this city.

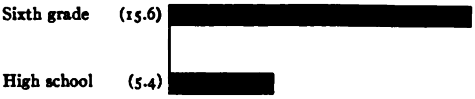

FIG. 29.—Showing the percentage of children in the sixth grade and in the high school whose mothers are engaged in remunerative employment. Mt. Vernon, May, 1921.

The facts for the successive high-school years show a constant decrease in the proportion of working mothers from the first year to the last. Thus, the percentage decreases from 8.9 in the Freshman, to 7.5 in the Sophomore, 6.1 in the Junior, and 5.3 in the Senior year. This change, to be sure, is not startling but it is large enough to be significant.

An examination of the returns for Mt. Vernon is of special interest, because of the inclusion of the sixth grade in the study. In Figure 29 a comparison of the high school and the sixth grade shows marked differences between the two groups. The latter has almost three times as large a proportion of working mothers as the former. If this situation is representative of American cities, we may say that, while it is uncommon for the mothers of high-school students to contribute to the family support by engaging in remunerative work, this condition obtains quite frequently among the children of the elementary school.

As a final contribution to this topic, a comparison of the four Bridgeport groups is presented in Figure 30. Again observe the clear differences in the social character of the young people brought together in these various schools and classes. At the one extreme are the compulsory continuation classes in which 15.4 per cent of the mothers are working outside the home, and at the other, according to expectations, the high school with a corresponding percentage of but 6.9.

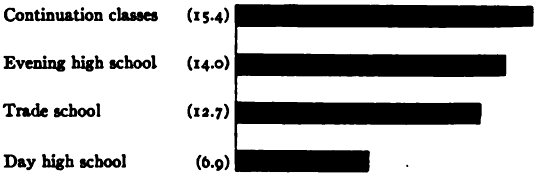

FIG. 30.—Showing percentage of children in each of four groups whose mothers are working at remunerative employment. Bridgeport, 1919–20.

BROTHERS AND SISTERS

It is natural to suppose that the number of children in the family is an important factor in determining the richness of the opportunity to be offered a particular child. Some have advocated limiting the birth-rate on the grounds that fewer children mean greater advantages for those who are born. And the decreasing birth-rate in wide sections of the population is one of the most fundamental tendencies in western society today.

In our investigation, inquiry was made as to the number of brothers and sisters of each child in all the groups studied, except the students in one of the Seattle high schools and the children at work in the same city. The general data for the high-school students are presented in Table XXXVII. A glance at the total number of students having each indicated number of brothers and sisters shows a distribution definitely skewed toward the lower end. The most frequent number of brothers and sisters is one, and a large proportion of these children have none at all. The medians also indicate that high-school students come from rather small families. By adding one to the median, we get the number of children in the family. This would make three the median number of children in the families of the students in the high schools of these four cities. There is some variation among the cities, which is probably explained in terms of the racial character of the population. Thus, the larger families in Bridgeport and Mt. Vernon are certainly due to the influence of the newer immigrant stocks, among which the birth-rate is still high.

TABLE XXXVII

NUMBER OF HIGH-SCHOOL STUDENTS IN FOUR CITIES HAVING EACH INDICATED NUMBER OF BROTHERS AND SISTERS

Number of Brothers and Sisters	Bridgeport	Mt. Vernon	St. Louis	Seattle	Total
0	270	119	1,294	696	2,379
1	485	287	1,952	1,212	3,936
2	465	232	1,565	1,036	3,298
3	376	177	1,082	690	2,325
4	241	102	712	490	1,545
5	186	60	408	290	944
6	114	55	252	169	590
7	59	18	139	97	313
8	30	14	71	65	180
9	16	16	41	23	96
10	9	4	18	12	43
11	1	....	2	4	7
12	5	....	1	2	8
13	....	....	....	....	....
14	....	....	....	1	1
Total	2,257	1,084	7,537	4,787	15,665
Median	2.3	2.1	1.8	2.0	2.0

We see no evidence of the elimination of the students coming from the larger families as we pass from the Freshman to the Senior year. An examination of the facts shows that the median number of brothers and sisters for the students in the first year is exactly the same as it is for those in the last, namely, two. Even the very large families are as well represented in the later as in the earlier years. Furthermore, the proportion of "only" children remains constant from year to year. It would seem, therefore, that, among those elements in the population which do get their children into the high school, the size of the family is not an important factor in further influencing attendance.

A comparison, however, of the high-school population with the pupils in the sixth grade in Mt. Vernon does reveal some substantial differences. As already stated in Table XXXVII, the median number of brothers and sisters for the former is 2.1. The corresponding figure for the children of the sixth grade is 3.0. But this difference is not to be construed as meaning that children are kept out of high school because of membership in large families, for the matter is not quite so simple as that. A more reasonable interpretation is that the size of the family is being limited by those classes in the population from which most of the high-school students come.

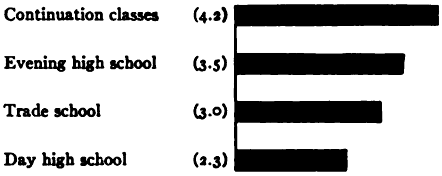

FIG. 31.—Showing median number of brothers and sisters for the children in each of four groups. Bridgeport, 1920–21.

Data from the three groups of children in Bridgeport of high-school age not in high school give similar results. The medians for these groups and the students attending the high school in the same city are presented graphically in Figure 31. The difference between the continuation classes and the high school is really striking, but the interpretation suggested in the previous paragraph in all probability holds here. It is becoming clearer and clearer, however, that there are certain social strata that are not reached by the public high school.

ORDER OF BIRTH

Is the order of birth a matter of consequence to the child? In a society in which no law of primogeniture operates, is it best to be born first or last? On the basis of the returns to the two questions—(1) How many brothers and sisters have you? and (2) How many are older than you?—an effort was made to throw some light on the matter. It was found very difficult, however, to disentangle the various factors involved, particularly in the study of the high-school groups alone, because the proportion of firstborn children in the high schools of a particular community is in some measure a function of population movements. In a new and rapidly developing community, inhabited by the younger generation, the proportion of firstborn in the high school will be disproportionately large, because of the youthful character of the adult population. Many of their firstborn and relatively few of their lastborn children will be in high school. We shall therefore merely refer to the data from Bridgeport where the high-school population may be compared with other groups of children of high-school age.

The results of the study in Bridgeport are given in Table XXXVIII. For purposes of comparison, the relation between the firstborn and the lastborn is expressed in a single figure, namely, the number of the latter for every one hundred of the former in each of the four groups. The striking thing about the table, perhaps, is the relatively large proportion of firstborn to lastborn children. In any total population they ought to be equal, since only those families are included in which there are two or more children. In each of such families there is always a firstborn and a lastborn child, even in the case of twins. What then is the explanation of the total situation in Bridgeport? It is that suggested in the previous paragraph. Bridgeport has grown very rapidly during recent years; its population is therefore relatively youthful; and consequently, the proportion of firstborn among children of high-school age is considerably greater than that of lastborn children. The latter have not yet reached this age in proportionate numbers. But the table shows wide differences among these groups. The high school has the smallest proportion of firstborn children and the continuation classes have the largest. The inference is clear that the firstborn children are handicapped in the struggle of life. On them, more than on their younger brothers and sisters, falls the burden of contributing to the family support.

TABLE XXXVIII

NUMBER OF FIRSTBORN FOR EVERY 100 LASTBORN CHILDREN IN EACH OF FOUR GROUPS OF CHILDREN OF HIGH-SCHOOL AGE IN BRIDGEPORT

High school	117
Trade school	121
Evening high school	159
Continuation classes	178

CHAPTER XII

THE PUBLIC HIGH SCHOOL AND THE IMMIGRANT

For at least three-quarters of a century we, as a nation, have faced the problems arising from the presence of a large immigrant population. Driven largely by economic considerations on the one hand and political forces on the other, the Irish and the Germans arrived in great numbers in the decade from 1845 to 1855. Since that time, up to the year of the Great War, with fluctuations due to the operation of various sociological forces, our immigration increased in volume and complexity. Gradually, as the years passed, the proportion from the less accessible and more backward countries of southern and eastern Europe increased, until toward the close of the nineteenth century we began to speak of the "new" immigration in contradistinction to the "old" from the north and west of Europe, which was culturally and racially more nearly allied to our own people. Today we are peculiarly conscious of the difficulties that attend the union of such diverse population elements.

In recent years much has been said and written about the relation of the immigrant to the public school, and numerous investigations have been made. Consequently this chapter will be cut down to its narrowest limits, and is included at all chiefly in the interests of a more complete sociological picture. Yet there are certain novel features of this study that will perhaps appeal to the reader.

Data bearing on this question were obtained in but two of the cities, Bridgeport and Mt. Vernon. Because of the small number of children of immigrant parentage in the schools of the latter, major attention will be given to the former. Although information concerning the country of birth for each parent was secured, the classification of the children in every instance follows the nativity of the father. This simplifies the tabulation of the data without detracting from the validity of the interpretation.

THE TOTAL ENROLMENT

As pointed out in an earlier chapter, the city of Bridgeport has a very large and varied immigrant population. In Table XXXIX the 2,257 students in the Bridgeport High School are classified according to the father's country of birth. For the sake of simplicity but ten divisions are used in this classification. In each case national units and boundaries are recognized as they existed in 1914, except that Poland is given distinct treatment. All the people from the old Austro-Hungarian Empire are grouped together, partly because the data did not in all cases indicate the particular part of this polyglot empire from which the fathers came. Under the British Empire are included all sections of the empire peopled by the white races, except Ireland. This has the merit at least of being satisfactory to most Irishmen and many Englishmen, as well as being justified sociologically. Norway, Sweden, and Denmark, following the customary practice, are classed together as Scandinavia. An effort was made to keep the Hebrews separate, but without success. They are consequently assigned to the particular countries in which they were born; but, from the information given concerning the language spoken in the home, it is evident that practically all fathers born in Russia are really Russian Jews.

TABLE XXXIX

NATIVITY OF THE FATHERS OF 2,257 STUDENTS IN THE BRIDGEPORT HIGH SCHOOL

Country of Father's Birth	Number	Percentage
United States	1,106	49.0
Austria-Hungary	207	9.2
British Empire (excluding Ireland)	155	6.9
Germany	51	2.3
Ireland	174	7.7
Italy	109	4.9
Poland	25	1.1
Russia	294	13.0
Scandinavia	108	4.7
All others	28	1.2
Total	2,257	100.0
Total foreign	1,151	51.0

According to this table the fathers of 49 per cent of the students in the Bridgeport High School were born in the United States. The remaining 51 per cent are of immigrant parentage, and are widely distributed over the countries of Europe, with Russia leading and Austria-Hungary occupying second place. But these figures have no special significance when taken by themselves. Let us, therefore, pass to some comparative data.

THE FRESHMAN AND SENIOR YEARS

A comparison of the Freshman and Senior years is of interest. In Figure 32 is shown, for each of the groups, the number of students in the Senior year for every one hundred in the Freshman year of the high school. At the top stands Germany with 61.1, while Poland foots the list with but 15.4. The United States occupies an intermediate position. On the whole the people from the north and west of Europe make a better showing than those from the south and east. The single exception to this generalization is the case of Russia, whose large Hebrew contingent is probably responsible for the fact that the people from this section of Europe are found in third place. These conclusions are supported by the data from Mt. Vernon.

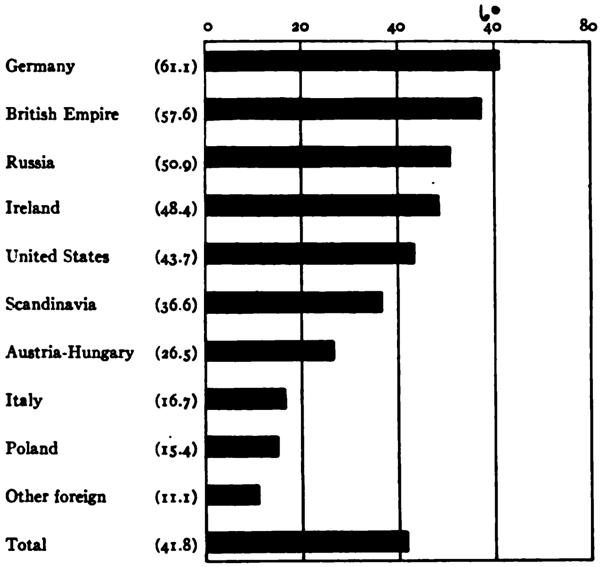

FIG. 32.—Showing for each ethnic group the number of students in the Senior year for every 100 in the Freshman year of the high school. Data from 2,257 cases. Bridgeport.

CHILDREN OF HIGH-SCHOOL AGE NOT IN HIGH SCHOOL

More significant perhaps than this comparison between the Freshman and Senior years is the comparison of the children in high school with the three groups outside, already studied in other connections. These are the children in the evening high school, the trade school, and the compulsory continuation classes. The facts are presented in Table XL in percentages. It is observed at once that children of native parentage are less well represented here than in the high school, while the reverse is true for the children of immigrants, taking them altogether. But an examination of the different immigrant stocks reveals great variation among them. A comparison of the percentages for these three groups with those for the high school given in the previous table shows greater proportional representation in the high school for the Irish, Russian Jews, and Scandinavians. In fact the Irish and the Russian Jews make almost as good a record as the native stock with their advantageous social and economic position. At the other extreme are the peoples of Austria-Hungary, the Italians, and the Poles, among whom the proportional representation is much greater in the three groups of children not in high school than in the high-school population. Another interesting feature of the table is the much greater representation of the Irish and the Russian Jews in the evening high school than in the trade school and the continuation classes. This indicates an unusually strong interest in an academic education on the part of these races, as well as exceptional energy and earnestness in the pursuit of educational opportunity, since voluntary attendance at evening school at best involves serious immediate, personal sacrifice.

TABLE XL

NATIVITY OF THE FATHERS OF CHILDREN IN EVENING HIGH SCHOOL, TRADE SCHOOL, AND COMPULSORY CONTINUATION CLASSES, BRIDGEPORT

Group of Children	United States	Austria-Hungary	British Empire	Germany	Ireland	Italy	Poland	Russia	Scandinavia	All Others	Total Percentage	Number of Cases
Evening high school........	22.6	21.4	7.0	5.8	9.9	9.5	4.1	13.6	4.1	2.0	100.0	243
Trade school..............	22.2	26.3	8.6	5.0	2.0	13.2	5.6	6.0	6.6	4.5	100.0	198
Continuation classes.......	17.8	33.7	7.5	3.2	1.8	24.2	5.9	3.7	1.7	.5	100.0	579
Total,................	19.8	29.3	7.6	4.2	3.8	18.5	5.4	6.5	3.2	1.7	100.0	1,020

The percentage of children in each of these four Bridgeport groups whose fathers were born in the United States is shown in Figure 33. Clearly the opportunities of secondary education are much more widely distributed among children of native parentage than among those born of immigrants.

A single set of facts from Mt. Vernon should be presented here. Owing to the very small numbers of children from most of the immigrant stocks in the schools of this city, it is hardly worth while to make the detailed analysis that has just been made for Bridgeport. There is one immigrant group, however, that is very well represented—the Italians. Consequently in Table XLI is given the number of children in the sixth grade and each year of the high school from each of three groups—the native stock, the Italians, and all others. Again, it is to be observed that the children of native parentage make a superior record and that among the other races the children of Italian fathers have an almost negligible representation in the later high-school years. For every one hundred children in the sixth grade the native stock has 30.2 in the last year of the high school; the Italians but 3.5; and all other immigrant groups 20.2.

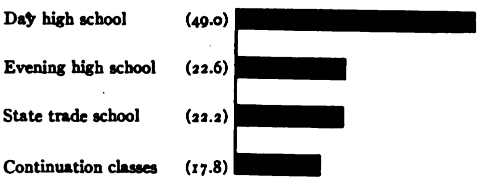

FIG. 33.—Showing the percentage of children in each of four groups whose fathers were born in the United States. Bridgeport.

TABLE XLI

NATIVITY OF FATHERS OF CHILDREN IN THE MT. VERNON SIXTH GRADE AND IN EACH YEAR OF THE MT. VERNON HIGH SCHOOLS

Country of Father's Birth	Sixth Grade	Freshman	Sophomore	Junior	Senior	Total
United States	295	234	194	133	89	945
Italy	256	59	29	8	9	361
All others	188	132	99	60	38	517
Total	739	425	322	201	136	1,823

THE CHOICE OF CURRICULA

It is interesting to see how the different racial groups respond to the curricular opportunities offered in the Bridgeport High School. Since the curricula for the girls are somewhat different from those for the boys, the two sexes will receive separate consideration.

In Table XLII are presented the curricular choices of the girls, grouped according to the nativity of the father. For convenience in comparison the distribution of each group of girls is expressed in percentages. Thus, of the 634 girls whose fathers were born in the United States, 24 per cent are pursuing the college preparatory course, 27 per cent the normal course, etc. If we note the percentage of girls from each of the groups pursuing each of the three popular curricula, some rather pronounced differences will be observed. The tendency for girls of native parentage to enter the college preparatory course is apparently considerably stronger than among girls of foreign parentage. Yet among certain of the immigrant groups, especially the Russian Jews and the people of the British Empire, excluding Ireland, the proportion to be found in this curriculum is almost as large as it is for the native stock. The Italians and the Irish are representative of the other extreme. The latter incline rather strongly toward the normal course. In fact 40 per cent of the Irish girls are planning to teach. The Russian Jews, on the other hand, show the least inclination in this direction. It is a fact worthy of attention in this connection that this curriculum is attracting a slightly larger percentage of the immigrant than of the native stock. The commercial course is also somewhat more attractive to the former, probably because of their lower social and economic level. Two-thirds of the Italian girls are enrolled in this course. Yet in Bridgeport, in every one of these groups, the percentage in the commer-

TABLE XLII

PERCENTAGE OF GIRLS IN EACH GROUP PURSUING EACH OF THE CURRICULA OPEN TO GIRLS IN THE BRIDGEPORT HIGH SCHOOL. GIRLS GROUPED ACCORDING TO NATIVITY OF FATHERS

Curriculum	United States	Austria-Hungary	British Empire	Germany	Ireland	Italy	Poland	Russia	Scandinavia	All Others	Total	All Foreign
College	24	18	22	14	7	5	17	23	9	27	21	16
Normal	27	23	36	25	40	28	25	21	24	20	27	28
Commercial	47	54	42	57	52	67	50	55	62	53	50	54
General	2	3	.....	4	1	.....	8	1	5	.....	2	2
Scientific	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total	100	100	100	100	100	100	100	100	100	100	100	100
Number of cases	634	97	88	28	100	43	12	145	58	15	1,220	586

cial course is larger than that to be found in any one of the other curricula.

It would be natural to suppose that the boys from these different groups behave somewhat as the girls do, but such is not the case, as a glance at Table XLIII shows. In contrasting the boys of native parentage with those of immigrant stock, it will suffice to confine our attention to but two of the curricula, the college preparatory and the scientific. No significant differences appear in the choice of the other curricula. Throwing all the immigrant groups together it will be observed that the college course is much more and the scientific course much less popular among these boys than among those of native parentage. This tendency to choose the college course is especially strong among the immigrants from the south and east of Europe, including the Russian Jews. On the other hand, certain of the peoples from the north and west, notably the Scandinavians and the Germans and representatives of the British Empire in smaller measure, exhibit the American inclination toward the scientific course. It is difficult to give an explanation of these differences since both of these curricula are primarily college preparatory. Apparently some of these groups are captivated by the name, at least in so far as the boys are concerned.

TABLE XLIII

PERCENTAGE OF BOYS IN EACH GROUP PURSUING EACH OF THE CURRICULA OPEN TO BOYS IN THE BRIDGEPORT HIGH SCHOOL. BOYS GROUPED ACCORDING TO NATIVITY OF FATHERS

Curriculum	United States	Austria-Hungary	British Empire	Germany	Ireland	Italy	Poland	Russia	Scandinavia	All Others	Total	All Foreign
College	23	47	26	18	40	36	61	59	16	31	33	42
Industrial arts	4	6	10	4	7	8	8	1	4	.....	5	5
Commercial	15	15	18	17	19	18	.....	9	4	38	14	14
General	5	3	3	.....	.....	3	.....	1	8	8	4	2
Scientific	53	29	43	61	34	35	31	30	68	23	44	37
Total	100	100	100	100	100	100	100	100	100	100	100	100
Number of cases	472	110	67	23	74	66	13	149	50	13	1,037	565

BOYS AND GIRLS

It is well known that there are more girls than boys in the American high school, there being only about 85 boys to every 100 girls for the country as a whole. This greater tendency for the girls to attend high school, however, is not characteristic of all the immigrant groups. Examine Table XLIV in which the ratio of boys to girls is given for each of the groups. Among those students whose fathers were born in the United States there are but 74.4 boys to every 100 girls. In the case of the Italians, on the other hand, the ratio is 153.5, and the boys are in the majority in three other groups—the people of Austria-Hungary, the Poles, and the Russians. Again is to be noted the cleavage between the north and west and the south and east of Europe. The people from the former exhibit the American trait of sending the girls to high school, while those from the latter seemingly are less inclined to regard a secondary education as necessary for girls.

TABLE XLIV

NUMBER OF BOYS TO 100 GIRLS IN BRIDGEPORT HIGH SCHOOL. STUDENTS GROUPED ACCORDING TO NATIVITY OF FATHER. DATA FROM 2,257 CASES

Country of Father's Birth	No. Boys to 100 Girls
United States	74.4
Austria-Hungary	113.5
British Empire	76.1
Germany	82.1
Ireland	74.0
Italy	153.5
Poland	108.3
Russia	102.8
Scandinavia	86.2
All others	86.7
Total	85.0
All foreign	96.4

CHAPTER XIII

THE PUBLIC HIGH SCHOOL AND THE NEGRO

It is a well-known fact that the negroes do not patronize the secondary schools of the country in large numbers. The reports of the Commissioner of Education, in so far as they present separate data for negroes, indicate a large amount of retardation and relatively early elimination for the race as a whole. Commenting on this matter the Biennial Survey of Education for 1916–18 by the Bureau of Education makes the following summary statement: "In short, over seven times as great a proportion of white pupils as colored pupils are to be found in secondary schools of the South."

The causes of this situation are undoubtedly complex, reaching far back into the history and the nature of the negro. And no claim is put forward here of a complete explanation. Some interesting facts, however, have come to light that have at least some bearing on the question.

Since the number of negroes in Bridgeport, Mt. Vernon, and Seattle is negligible, no reference will be made in this chapter to data collected from these cities. St. Louis, on the other hand, as the population statistics already given show, does have a considerable negro population. Following the custom of the South this city maintains a dual system of education for the white and colored races, extending into the secondary field. One of the six St. Louis high schools, Sumner, is a negro high school. It is extraorinarily well attended, with an enrolment of over eight hundred. In fact, in proportion to the number residing in St. Louis, the negroes have as large an attendance in the public high schools as the whites. This is a remarkable showing, and it adds some interest to this part of the study.

Seven hundred and twenty-seven students in the high school filled out the information card. While this was not the total enrolment, it did include practically all who were present on the day this census was taken. The distribution of these young people according to sex and year in the high school is given in Table XLV. It will be observed that there are almost twice as many girls as boys. This seems to be characteristic of negroes generally, as it accords with the facts presented in the reports of the Bureau of Education and some other studies that have been made. As already noted, this is a cultural trait peculiar to the civilization of America and the north and west of Europe.

TABLE XLV

Distribution by Sex and Year in High School of 727 Students in the Sumner (Colored) High School of St. Louis

Sex	Freshman	Sophomore	Junior	Senior	Total
Girls........	173	115	105	91	484
Boys........	102	66	32	43	243
Total....	275	181	137	134	727

FATHER'S OCCUPATION

Naturally these colored children would be expected to present an occupational representation quite different from that of the white children and characteristic of their race. Only slowly and against the most gigantic obstacles have the negroes been working their way upward through the several occupational levels since their emancipation from slavery less than three generations ago. At present the great majority of the members of this race in our cities are engaged in occupations requiring little skill. Their history has associated them with personal service. Since they own relatively little property few are found in those occupations which are based on its ownership, such as the proprietary and managerial callings. Furthermore, owing to a distinctly limited demand for professional service within the race, the number so engaged is small.

The occupations of the fathers of these 727 students are shown in Table XLVI. According to the facts here presented, as might be expected, personal service has the greatest representation, including 22 per cent, almost one-fourth of the total number. Common labor is second, and the machine trades third. It is perhaps surprising to find the clerical occupations occupying the fourth place, but this may be explained in terms of politics, since approximately three-fourths of them are mail clerks. Professional service is also represented in larger measure than might be expected. It should be remembered, however, that this type of service is not quite so rigid in its meaning as among the white population. Neither are the lines between occupations drawn so clearly. This fact is brought out by noting the composition of the several high-school years through data not presented in this table. The tendency noted again and again of certain of the occupational groups to maintain themselves in the high school is not apparent here. The proprietors and professionals, for example, are no better represented in the Senior than in the Freshman year. The only exception to the forgoing general statement is found in the case of common labor, which does exhibit the same traits as among the whites, but to a less marked degree.

TABLE XLVI

OCCUPATIONS OF THE FATHERS OF 727 STUDENTS IN THE SUMNER (COLORED) HIGH SCHOOL OF ST. LOUIS

Parental Occupation	Number	Percentage
Proprietors	21	2.9
Professional service	48	6.6
Managerial service	38	5.2
Commercial service	11	1.5
Clerical service	57	7.9
Agricultural service	30	4.1
Artisan-proprietors	28	3.8
Building trades	24	3.3
Machine trades	66	9.1
Printing trades	2	.3
Miscellaneous trades	16	2.2
Transportation service	48	6.6
Public service	5	.7
Personal service	160	22.0
Miners, lumber-workers, fishermen	6	.8
Common labor	90	12.4
Unknown	77	10.6
Total	727	100.0

FAMILY INFLUENCES

The negro family is not noted for its stability, and there are probably few factors of more importance in determining high-school attendance than the character of the family. Although it would be highly desirable to present data here dealing with the negro family in its varied aspects, this is not possible. Information was secured only on a few items. These, however, will be found to be significant.

The first and most important matter pertains to the mortality of the parents. Obviously the death of one of the parents is a most serious matter in the life of the child, particularly among those classes of the population whose standard of living approximates the margin of existence. In Table XLVII the facts for the students attending the Sumner

High School are compared with those for the students attending the other St. Louis high schools. And in Figure 34 the totals for the negro and white children are contrasted. According to the facts presented in this table 27.9 per cent of the negro children come from homes in which one or both parents are dead. This is more than one in every four students and is over twice the rate for the children of white parentage. The difference between the two races is more marked in the loss of the mother than in the loss of the father; while the greatest contrast is seen in the loss of both parents, the rate for the negroes here being four times that for the whites. The high mortality rate among the negroes has long been noted. It is probably a function of their standard of living and mode of life. But its bearing on educational opportunity has not received adequate recognition. Clearly this is an important consideration in a social order where large responsibilities for the education of the children still rest on the home.

TABLE XLVII

PERCENTAGE OF STUDENTS IN THE COLORED AND WHITE HIGH SCHOOLS OF ST. LOUIS HAVING ONE OR BOTH PARENTS DECEASED

High School	Father Deceased	Mother Deceased	Both Parents Deceased	Total
Sumner High School (colored).......	12.8	10.0	5.1	27.9
Other St. Louis high schools (white) .	7.6	3.8	1.3	12.7

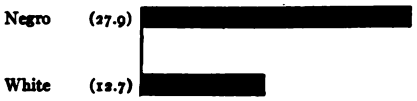

FIG. 34.—Comparing the negro and white high-school students in St. Louis with respect to the percentage having one or both parents deceased.

Another significant measure of the integrity of the home is found in the occupation of the mother. Is the mother helping to support the family by working at some form of remunerative employment outside the home? Here again, in Figure 35, the negro and white students in the St. Louis high schools are compared. And, again, the unfavorable position of the former is noted. Over 30 per cent of the negro mothers are helping to support the family, whereas only 5.6 per cent of the mothers of the white children are so engaged. As a matter of fact, no occupational group among the latter even approches the negroes in this matter. As might be expected, the common laborers present a record nearest that of the negroes, but even here only 13 per cent of the mothers are helping to support the family.

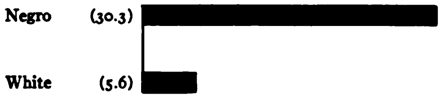

FIG. 35.—Showing percentage of negro and white children in St. Louis high schools whose mothers are engaged in remunerative employment.

The size of the family from which the high-school students come is almost the same for the two races, if we think in terms of medians. For the negroes the median number of children in the family is 3.1; for the whites it is 2.8. The distribution of the size of the family for the two races, however, is somewhat different, as is shown in Figure 36.

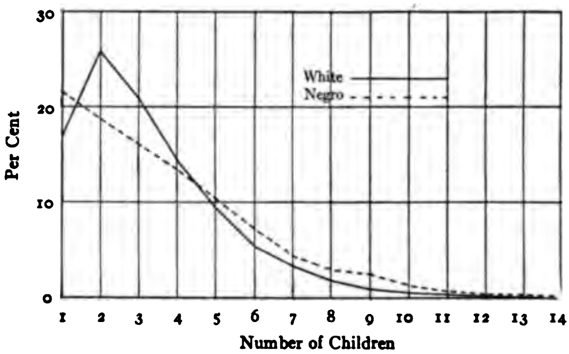

FIG. 36.—Comparing whites and negroes with respect to size of family from which the high-school students come. St. Louis.

The curve for the negroes is a peculiar one. It shows the most frequent number of children per family to be one. Whether this curve is characteristic of the negroes in St. Louis or to be explained in terms of the operation of a selective principle in the high-school population, it is impossible to say.

CHOICE OF CURRICULA

The children in the Sumner High School are offered practically the same choice of curricula as the children in the other St. Louis high schools. In view of the difference already noted in the social composition and occupational outlook of the two races, it would be natural to expect the negro children to exhibit distinctive traits in the selection of courses. It will be interesting to survey the facts.

Table XLVIII presents the curricular choices of the 484 negro girls in comparison with corresponding data from 3,978 girls of white parentage. The facts are given in percentages to make the comparison easy. An examination of the table will show that there are just two points at which the two races exhibit sharp differences. In the first place, the four-year home economics course appears to be actually popular among these colored girls, over 30 per cent of them taking it. This is the only group discovered in the four cities that seems to be interested in this course. It might be explained on the grounds that these girls are preparing for personal service, but data to be presented later indicate that only one of the 484 girls displays any intention of entering this occupation following graduation from high school. In the second place, the two-year commercial course is distinctly unpopular among these girls. Among the girls of white parentage, on the other hand, this course draws more students than any other course during the first and second years, except the general course, which points particularly to college. This difference may be due in part to inferior opportunities to enter into the clerical occupations on the part of colored girls. Perhaps, after all, the surprising thing about the facts presented in this table is that both races register practically the same proportion of

TABLE XLVIII

PERCENTAGE OF GIRL STUDENTS IN THE COLORED AND WHITE HIGH SCHOOLS OF ST. LOUIS PURSUING THE DIFFERENT CURRICULA

Curriculum	Negro	White
Four-year general	43.4	44.1
Four-year scientific	.6	.6
Four-year commercial	23.6	21.6
Four-year home economics	30.4	9.5
Four-year classical	....	1.0
Four-year fine arts	1.6	3.6
Two-year commercial	.4	18.5
Two-year home economics	....	.4
One-year commercial	....	.7
Total	100.0	100.0

the girls in the general course. This indicates a strong college tradition in the Sumner High School, as well as in the other high schools of the city.

Among the boys the differences are more pronounced than among the girls, as a glance at Table XLIX will prove. This is somewhat surprising because, among the whites, the girls appear to be more bound by the occupational group from which they come than are the boys.

TABLE XLIX

PERCENTAGE OF BOY STUDENTS IN THE COLORED AND WHITE HIGH SCHOOLS OF ST. LOUIS PURSUING THE DIFFERENT CURRICULA

Curriculum	Negro	White
Four-year general	14.0	42.1
Four-year scientific	9.5	9.4
Four-year commercial	20.2	12.2
Four-year manual training	54.7	23.9
Four-year classical	....	.8
Four-year fine arts	1.2	1.2
Two-year commercial	.4	5.3
Two-year manual training	....	4.7
Two-year printing	....	.3
One-year commercial	....	.1
Total	100.0	100.0

There the boys tend to break over the class lines, while the girls conform to them. Only a small percentage of the colored boys are pursuing the general curriculum, in which are enrolled 42 per cent of the white boys. The four-year manual training course, on the other hand, is extremely popular with the negroes. Almost 55 per cent of them are taking it. The four-year commercial course is also much more popular among them than among the whites. The various short courses appeal to the boys of neither race.

EXPECTATIONS FOLLOWING GRADUATION

Perhaps just as significant as the curriculum chosen, if not more so, is the statement of expectations of the students following graduation. To be sure, little weight can be attached to these statements as indexes of what these boys and girls will actually do when they leave the high school. In truth, the evidence is quite strong in the other direction, namely, that many of them will not do that which they say they will do. But, as an index of the traditions and atmosphere of the school, these statements undoubtedly have weight.

A glance at Table L shows quite conclusively that at least according to their statements the negro girls are not intending to enter the occupations in which their parents are engaged. Apparently they plan to attend college in proportionately larger numbers than do their white sisters. They are likewise attracted to the normal school in such numbers as to set at rest any fear among the champions of education lest the colored schools be closed for lack of teachers. It should also be noted that many of those mentioning the college as their immediate objective, intend ultimately to enter the teaching profession. And the 13.5 per cent grouped under professional service includes a large proportion who are expecting to begin teaching with only the high-school training. Clearly teaching is attractive to these young people. The profession still retains the prestige which it has lost among members of the other race. A summary inspection of the table shows that the occupational interest which dominates this group of negro girls is the professional, and that they are hoping the high school will provide a means of escape from the wage-earning class from which they come and back to which most of them will probably have to go.

TABLE L

EXPECTATIONS FOLLOWING GRADUATION OF GIRLS IN THE COLORED AND WHITE HIGH SCHOOLS OF ST. LOUIS

Expectations	Negro	White
College	35.3	33.7
Normal school	26.2	3.7
Business college	2.1	4.2
Other school	3.9	1.6
Travel	....	.1
Home	....	1.6
Professional service	13.5	4.9
Commercial service	.2	.3
Clerical service	11.6	30.3
Industrial service	1.5	.5
Personal service	.2	....
Work	2.4	4.3
Undecided	3.1	14.8
Total percentage	100.0	100.0

The negro boys also are intent on a higher education. This is seen in Table LI. According to their statements 63 per cent of these boys are planning to attend college. This is almost 12 per cent greater than for the boys of white parentage. A second interesting feature of the table is the relatively large proportion of colored boys looking toward the industrial occupations. But this is absolutely quite small, amounting to only 8.7 per cent. A third point of interest is the smaller proportion of negroes who are undecided. A glance at the preceding table shows this to be true of the girls as well as the boys.

In conclusion it may be said that this brief and somewhat superficial study of the population of a single negro high school throws some light on the relation of the negro to our secondary schools. His relative absence of interest in the high school is rather easy to understand. As a race the negroes are engaged in occupations which require little skill, for which the remuneration is low, and whose respectability is not high. Their standard of living is also low, and the home is not the center of stimulation and inspiration that it is among other groups in the population. The family is notoriously unstable because of the absence of those traditions that would give it stability. The high mortality of the race also acts as a disorganizing and disintegrating force in many negro homes. Taking into consideration these various influences, the attendance at the Sumner High School in St. Louis is little short of marvelous. These young people are carrying on a struggle for secondary education that is really unique in the annals of American education. The obvious handicaps under which they are striving can be duplicated by few social groups in this country today outside their own race. The present study shows no group within the white popula-

TABLE LI

EXPECTATIONS FOLLOWING GRADUATION OF BOYS IN THE COLORED AND WHITE HIGH SCHOOLS OF ST. LOUIS

Expectations	Negro	White
College	63.0	51.4
Business college	....	.5
Other school	4.6	2.2
Travel	.4	.1
Farming	.4	.4
Professional service	1.2	1.0
Commercial service	.8	3.2
Clerical service	5.3	5.5
Industrial service	8.7	2.6
Public service	....	.1
Personal service	.8	....
Transportation service	....	.3
Work	7.8	16.7
Undecided	7.0	16.0
Total percentage	100.0	100.0

tion in the four cities investigated waging the fight so successfully and against such tremendous odds, as is the negro population of St. Louis. Those elements of the white population that might be regarded as approximating the negroes in standard of living, social tradition, and the general organization of life are very far from doing as well. The children from these groups hardly get into the high school at all. It is very doubtful if, outside the negro populations of a very few of the large cities midway between the north and south, such as Washington, there is any population group within the nation that is doing so much to send its children to high school as are the negroes of St. Louis.

CHAPTER XIV

THE PUBLIC HIGH SCHOOL AND PSYCHOLOGICAL SELECTION

It has been made clear in the earlier chapters that the student population of the public high school is sociologically highly selected. It remains to consider briefly the question of psychological selection—briefly because this does not constitute the central part of the study and because much has been done in this field in recent years.

Psychological tests were given to the four groups of children in Bridgeport and to the students in the first year of the high school in Mt. Vernon. In the former city the Chapman-Welles Junior and Senior High School Classification Test was used and in the latter the National Intelligence Tests, Scale B, Form 1. We shall now examine the data secured from these two cities, giving special attention to the data from Bridgeport, because of the more comprehensive study made there.

CHILDREN OF HIGH-SCHOOL AGE IN HIGH SCHOOL AND OUT

The median scores made by the girls and boys in each of the high-school years in Bridgeport are given in Table LII. Although the facts in this table, apart from a comparison with data from the other groups studied in this city, are of no great significance to this study, there are several points of interest to be noted. The median score increases noticeably in the successive years of the high school, yet for both sexes the most pronounced difference occurs between the Freshman and Sophomore years. This may be due to disproportionate elimination

TABLE LII

MEDIAN SCORES MADE BY GIRLS AND BOYS IN EACH YEAR OF THE HIGH SCHOOL IN BRIDGEPORT—CHAPMAN-WELLES TEST. DATA FROM 2,537 CASES

High-School Year	Girls	Boys
Freshman	72.9	89.7
Sophomore	90.8	101.8
Junior	95.4	110.7
Senior	99.2	113.8
Number of cases	1,362	1,175

at this point in the high school, but more probably to the fact that the test is not well adapted to measuring differences among the more mature students in the later high-school years. It is also observed that the median score for the boys is in each case appreciably higher than that for the girls. It seems probable that this is likewise to be explained in terms of the organization of the test.

But it is the comparison with these other groups of children of high-school age that interests us. These comparative scores are presented in Table LIII. No score is given for the girls in the first year of the trade school because the number of cases was entirely too small to insure reliability. The outstanding fact in the table is that, speaking in terms of medians, the children in the Freshman year of the high school are distinctly superior to those in the other groups. And in the case of the evening high school the difference is more significant than these scores indicate, because these students are on the average two to three years older than those in the first year of the high school. In Figure 37 a graphical comparison is made of the median scores for the boys in these four groups. No comment is necessary.

TABLE LIII

Median Scores Made by Girls and Boys in the First Year of the High School, the Evening High School, the First Year of the Trade School, and the Compulsory Continuation Classes in Bridgeport—Chapman-Welles Test

Group	Girls	Boys	Number of Cases
First year high school	72.9	89.7	910
Evening high school	60.0	78.1	181
First year trade school	....	62.0	112
Continuation classes	29.1	40.9	421

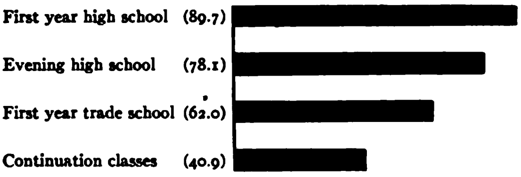

Fig. 37.—Showing the median score made in the Chapman-Welles Test by the boys in each of four groups. Bridgeport.

Median scores, however, tell but a part of the truth. For this reason Figure 38 was constructed, in which is presented the complete distribution of the scores made by each of three groups of boys, those in the first year of the high school, those in the first year of the trade school, and those in the compulsory continuation classes. The boys in these three groups are of approximately the same age. Observe the character of the curves. The curve for the high-school Freshmen shows a fairly normal distribution about a center of superior ability, while that for the continuation classes exhibits a similar distribution about a center of mediocre or inferior ability. On the other hand, the curve for the first year of the trade school shows a wide and somewhat irregular distribution. The first two curves are to be expected, but why this peculiar distribution for the trade school? The probable explanation is to be found in the educational status of this institution and the attitude of school teachers and others toward it. There is no policy of admission that would close the doors of the trade school to children judged inferior by academic standards. In many instances, as a matter of fact, children who have failed in the conventional curriculum are encouraged to try this school. This accounts for the large number of

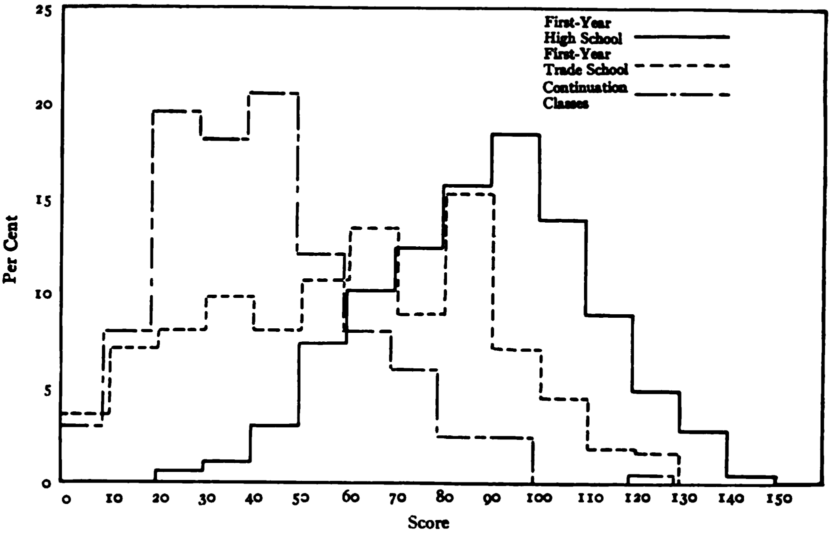

FIG. 38.—Showing by percentages the distribution of scores made by each of three groups of boys in the Chapman-Welles Test. Data from 426 boys in the first year of the high school, 112 boys in the first year of the trade school, and 201 boys in the compulsory continuation classes. Bridgeport.

cases at the lower end of the distribution, but it does not explain the presence of many children of average and even superior ability. Apparently they enter the trade school either through necessity or because of interest in, or an aptitude for, various types of manual activity.

Perhaps a word should be said about the overlapping of these curves. This is certainly just as significant as the fact of median differences. There is very large overlapping between the high-school and trade-school curves, and even the compulsory continuation classes hold a considerable area in common with the high school Freshmen. Although the children in these classes have in the main been rejected as unfit by the school, there is a surprisingly large amount of ability to be found among them. There are even a few of distinctly superior promise, at least as measured by this test. On the other hand, in the high school there are some children of remarkably inferior ability. Thus, while we may say that the high-school population represents a certain measure of psychological selection, it is clear that this principle does not operate conclusively in a negative fashion and much less in a positive way in determining attendance at high school. Neither are all of meager intellectual endowment barred from high school, nor are all possessing superior talent to be found within its doors.

There is another point of interest in the data from the trade school that deserves some comment. The boys in the second year not only did not do as well in the test as those in the first year, but they actually made a median record almost ten points lower. As already given in the table, the median for the first year is 62.0, while that for the second year is but 52.9; and it should be noted further that there is a median age difference of 1.3 years in favor of the second-year boys. While no sweeping conclusions may be drawn from data from a single school, these facts give rise to the suspicion that the work of the trade school is not of such a character as to demand ability of the type measured by this and similar tests.

CHOICE OF CURRICULA

That a certain amount of psychological selection is expressed in the choice of curricula is to be expected. The extent to which this occurs in the Bridgeport High School is shown in Table LIV. Here are given the median scores made by both boys and girls pursuing the various curricula in each year of the high school. Data are presented for but three curricula for each sex, because of the very small number of students to be found in the other curricula offered. Examination of that part of the table presenting the facts for the girls reveals appreciable differences. Averaging the medians for the four years we get a record for the girls in the college preparatory course of 95.9, as compared with 89.8 for those in the normal course and 86.8 for those in the commercial course. These differences are not large, and there is great overlapping of the distributions, but they do indicate some selection.

TABLE LIV

MEDIAN SCORES MADE BY GIRLS AND BOYS IN THE VARIOUS CURRICULA IN THE BRIDGEPORT HIGH SCHOOL—CHAPMAN-WELLES TEST

CURRICULUM	FRESHMAN	SOPHOMORE	JUNIOR	SENIOR	AVERAGE	NO. CASES
	Girls					
College	73.0	97.7	101.0	111.7	95.9	271
Normal	75.4	87.0	95.7	98.0	89.8	376
Commercial	71.8	89.4	91.6	94.4	86.8	715
Total	72.9	90.8	95.4	99.2	89.6	1,362
	Boys					
College	92.5	105.3	113.0	118.0	107.2	371
Scientific	86.3	100.8	114.6	111.5	103.3	556
Commercial	82.9	100.9	121.5	135.0	110.1	148
Total	89.7	101.8	110.7	113.8	108.7	1,075

Turning to the other half of the table, which gives the facts for the boys, we observe no consistent tendency for any one of the groups to show superiority from year to year. There are some average differences, but they are not significant. The absence of any definite selection here may be due to the fact that no one of these curricula is strictly vocational, although the commercial course approaches it. If the number in the industrial arts course were sufficiently large to furnish reliable medians, it is probable that some selection would be found among the boys.

In Mt. Vernon the National Intelligence Tests were given to the high-school Freshmen. The median scores made by both sexes in the different curricula are given in Table LV. The several academic curricula are grouped, and no data are given for the girls pursuing the industrial arts course because of an insufficient number of cases. It is at once apparent that in Mt. Vernon the academic curricula are attracting the students of superior ability regardless of sex, while the lowest record is made by the boys in the industrial arts course. Yet it should be noted that there is much overlapping, and that in the vocational courses there are many students of unusual talent.

TABLE LV

MEDIAN SCORES MADE BY FRESHMAN GIRLS AND BOYS IN EACH TYPE OF CURRICULUM IN THE MT. VERNON HIGH SCHOOL—NATIONAL INTELLIGENCE TESTS

CURRICULUM	GIRLS		BOYS	
	Median Score	No. of Cases	Median Score	No. of Cases
Academic	155.3	157	155.0	180
Commercial	144.1	85	147.5	67
Industrial arts	....	....	130.0	34

PARENTAL OCCUPATION

In Table LVI are given the scores made in the Chapman-Welles Test in the Bridgeport High School by the students grouped according to the occupation of the father, the boys and girls being kept separate because of the sex differences already noted. For each group the median scores for the four high-school years are averaged. Several of the

TABLE LVI

SCORES MADE BY GIRLS AND BOYS FROM DIFFERENT OCCUPATIONAL GROUPS IN THE CHAPMAN-WELLES TEST. IN EACH CASE THE MEDIAN SCORES MADE IN THE FOUR HIGH-SCHOOL YEARS ARE AVERAGED. DATA FROM BRIDGEPORT HIGH SCHOOL

PARENTAL OCCUPATION	GIRLS		BOYS	
	Average of Medians	No. of Cases	Average of Medians	No. of Cases
Proprietors	91.8	213	105.4	193
Professional service	103.3	66	104.8	59
Managerial service	94.5	191	109.4	161
Commercial service	94.3	77	110.5	71
Clerical service	95.8	55	107.7	31
Artisan-proprietors	85.1	59	107.8	39
Buildings trades	91.3	54	103.7	47
Machine trades	92.3	161	107.3	131
Miscellaneous trades	84.8	74	107.9	51
Transportation service	84.8	36	112.5	28
Personal service	81.3	23	101.9	19
Common labor	90.0	16	95.0	17
All manual-labor occupations	88.8	404	105.8	316
All occupations	91.6	1,128	106.9	898

occupational groups are omitted from this table because of inadequate representation in one or more years. For the purpose of focusing special attention on the laboring groups they are all combined into a single group at the bottom of the table. In this group are included the building, machine, printing, and miscellaneous trades, the transportation workers, public service, personal service, and common labor.

An examination of the table shows no clear differences. And the evidence from the separate years of the high school, not given here, supports this statement. Although for both the girls and the boys the combined labor groups do average a point or so lower than the entire high-school population, the difference is so small as to constitute an entirely insufficient basis on which to build sweeping conclusions. In Bridgeport at least the high-school students from the various occupational groups exhibit about the same measure of ability. This indicates again that the children of manual laborers who get into the high school are relatively highly selected, since the testing of an unselected group of children from this source shows an intelligence level appreciably lower than that of children from the professional and more prosperous classes.

TABLE LVII

MEDIAN SCORES MADE BY FRESHMEN OF THE MT. VERNON HIGH SCHOOL IN THE NATIONAL INTELLIGENCE TESTS, CLASSIFIED ACCORDING TO THE OCCUPATION OF THE FATHER

Parental Occupation	Median Score	No. of Cases
Proprietors	147.9	50
Professional service	158.2	25
Managerial service	152.5	23
Commercial service	152.5	22
Clerical service	138.2	13
Artisan-proprietors	152.5	12
All laboring groups	141.5	48

In Mt. Vernon, however, we do find some differences in the small group in the Freshman class for whom we have all the necessary data. The facts are presented in Table LVII. In order to secure a sufficiently large number of cases for statistical purposes all the laboring groups are combined. If the record made by the children of this combination group is compared with records made by those whose fathers are engaged in other occupations, the comparison is found to be somewhat unfavorable to the laboring classes, although the clerical service does show a slightly lower record. But even in Mt. Vernon the complete distributions show the differences to merit less attention than the points of agreement.

THE IMMIGRANT

The test records made by the high-school students in Bridgeport, classified according to the father's country of birth, appear in Table LVIII. Since this table is organized in the same way as the previous table giving similar data for the occupational groups, no explanation is necessary. If we compare the records made by the combined immigrant groups with those made by children of native parentage, they are found to be almost identical, the boys displaying slight superiority in the former and the girls in the latter group. These differences are not large enough to enable us to say, however, that the immigrant boys are superior and the immigrant girls inferior to the American children in this high school. With the exception of the Italian and Polish children, whose records are considerably below the average for both sexes, the children of foreign parentage appear to hold their own very well.

TABLE LVIII

SCORES MADE IN CHAPMAN-WELLES TEST BY GIRLS AND BOYS, CLASSIFIED ACCORDING TO NATIVITY OF THE FATHER. MEDIAN SCORES MADE IN THE FOUR SCHOOL YEARS ARE AVERAGED IN EACH CASE—BRIDGEPORT HIGH SCHOOL

Country of Father's Birth	Girls		Boys	
	Average of Medians	No. of Cases	Average of Medians	No. of Cases
United States	92.5	586	106.7	405
Austria-Hungary	84.1	93	109.2	97
British Empire	92.1	82	108.7	57
Germany	86.0	27	111.9	19
Ireland	90.3	98	100.5	66
Italy	80.0	39	99.0	55
Poland	83.8	8	99.4	10
Russia	91.8	135	109.2	132
Scandinavia	93.9	51	106.3	49
All foreign countries	90.6	644	107.1	493

A similar situation is found among the Freshmen in the Mt. Vernon High School. Since the number of children of immigrant stock is small, they are all included in a single group. This gives us for the girls of native and foreign parentage the median scores of 155.5 and 151.3 respectively. The corresponding scores for the boys are 156.2 and

154.0. There is in each case a slight difference favoring the former, but hardly large enough to deserve comment. We may say, therefore, that, regardless of any differences in ability that may be found in unselected groups of children from the native and various immigrant stocks, such differences are practically obscure in the high-school population.

FAMILY INFLUENCES

A study of the records made in the tests by the firstborn and lastborn in families of two or more children brings to light evidence which supports the conclusions in an earlier chapter that selective influences are operating at this point. In Table LIX are compared the scores made in the Chapman-Welles Test by the firstborn and lastborn children in the Bridgeport High School. As in previous tables, in order to get a single measure for each group the median scores made by the students in the four years are averaged. For both the boys and the girls, it will be observed, the firstborn make a score significantly larger than that made by the lastborn children.

TABLE LIX

Comparison of Scores Made by Firstborn and Lastborn Children in the Bridgeport High School in the Chapman-Welles Test. In Each Case the Median Scores Made in the Four High-School Years Are Averaged

Order of Birth	Girls		Boys	
	Average of Medians	No. of Cases	Average of Medians	No. of Cases
Firstborn	94.8	287	108.3	264
Lastborn	87.8	247	102.8	205

Among the Freshmen of the Mt. Vernon High School the same relation is found, as an examination of Table LX will show. What is the explanation? Certainly not that firstborn are brighter than lastborn children, but rather that the former in the high school are more highly selected groups than the latter. Among certain elements of the population the firstborn child is more likely to be called on to sacrifice his own educational opportunities in the interests of the family than is the lastborn. Especially, if he does not possess unusual ability, it seems that he will receive less encouragement than his younger brother or sister to remain in school. In other words, that general tendency of the high school to select children of superior talent and reject others operates with peculiar force among the firstborn, because of the influence of certain sociological factors.

TABLE LX

Comparison of Median Scores Made in the National Intelligence Tests by Firstborn and Lastborn Children in the Mt. Vernon High School

Order of Birth	Girls		Boys	
	Median Score	No. of Cases	Median Score	No. of Cases
Firstborn	151.3	27	154.2	38
Lastborn	147.5	22	146.7	24

It is also interesting to note the relation of ability to the number of children in the family, keeping in mind of course that the validity of these tests is assumed. The facts from the Bridgeport High School are presented in Table LXI. It will be observed that the students are classified into three groups on the basis of the number of children in the family from which they come. First, there is the family with an only child; second, the family with from two to four children; and third, the family with five or more children. According to this table the score seems to vary inversely with the size of the family for both the girls and the boys.

TABLE LXI

Comparison of Scores Made in Chapman-Welles Test by Children Coming from Families of Three Different Sizes in the Bridgeport High School. In Each Case the Median Scores Made in the Four High-School Years Are Averaged

Number of Children in the Family	Girls		Boys	
	Average of Medians	No. of Cases	Average of Medians	No. of Cases
1	94.2	118	113.6	112
2–4	92.6	599	107.0	523
5+	89.3	308	104.2	263

Data bearing on this same point from Mt. Vernon appear in Table LXII. The evidence here corroborates the findings in Bridgeport. Apparently the superior children exist in proportionately larger numbers in the smaller families. But the explanation is probably to be found in the voluntary limitation of the birth-rate among the more intelligent and foresighted elements of the population. The ultimate effect of such a policy on the soundness and quality of the racial stock is obvious, but a discussion of this matter is beyond the scope of this study.

TABLE LXII

COMPARISON OF MEDIAN SCORES MADE IN THE NATIONAL INTELLIGENCE TESTS BY CHILDREN COMING FROM FAMILIES OF THREE DIFFERENT SIZES IN THE MT. VERNON HIGH SCHOOL

No. of Children in the Family	Girls		Boys	
	Median Score	No. of Cases	Median Score	No. of Cases
1	148.8	9	165.0	8
2–4	146.7	62	151.4	63
5+	139.2	19	139.6	39

CHAPTER XV

THE POPULATION OF THE PRIVATE SECONDARY SCHOOL

There are in the United States 158,745 students enrolled in the private secondary schools, according to the report of the Federal Bureau for the school year 1917–18. While the proportion of the total secondary-school population to be found in these schools has been decreasing gradually for fifty years and probably for an even longer period, the number is still sufficiently large to receive attention in any study of this character. This chapter may, therefore, be regarded as a supplement to the more detailed study of the social composition of the public high-school population reported in the preceding chapters. It will throw additional light on the extension of the opportunities of secondary education to the various strata of American society.

But there is a second consideration that lends significance to this part of the study. It has been remarked that in the primitive peoples inhabiting various parts of the globe today we may see our contemporaneous ancestors. While this construction must not be taken literally, since each people, even the most primitive, has experienced a longer or shorter period of evolution that has produced certain unique and special characteristics, it does contain a certain element of truth. So in the private secondary schools of today we see preserved some of those features which characterized the secondary institutions of a few generations ago, before the rise of the public high school. By comparing the high-school population with that of the private secondary schools we may, therefore, get some idea of the distance we have traveled in actual practice from the conception of secondary education as class education. Of course there are certain forces operating today to determine the character of the population of these private schools which did not affect the schools of the earlier period, but in general the impression made by the comparison probably corresponds with the facts. The elements in the population which patronize the private secondary schools today in all probability gave their children a secondary education in the days when it was not free and when it looked toward the college altogether. To be sure, a considerable number of parents who do not patronize the private secondary schools would send their children to these schools today if there were no public schools of secondary grade, but it is not probable that these additions would greatly change the social complexion of the student population there enrolled.

THE SCHOOLS STUDIED

Data were secured from two schools: the one, a day school in the Middle West, and the other, a famous boarding-school in New England. They are respectively the University of Chicago High School in Chicago, Illinois, and the Phillips-Exeter Academy at Exeter, New Hampshire.

Owing to the very rapid development of Roman Catholic secondary schools during the last twenty years, an effort was made to secure the facts from one of these schools, but without success. The administrative officers approached seemed not to be interested in a study of this character.

Perhaps a few words should be set down concerning the nature of the two schools studied. Exeter Academy is a non-sectarian school offering a four-year academic course and enrolling about 575 students, all of whom are boys. The University of Chicago High School is coeducational and non-sectarian and is definitely college preparatory. Its registration is about 475. Both schools have tuition fees, that of the former being $200 and that of the latter $275. In addition to the tuition fee at Exeter there are the annual charges for room and board and other assessments which range from $336 to $1,091, according to the catalogue for 1920–21.

TABLE LXIII

OCCUPATIONS OF FATHERS OR GUARDIANS OF 201 STUDENTS IN PHILLIPS-EXETER ACADEMY AND 418 IN THE UNIVERSITY OF CHICAGO HIGH SCHOOL

PARENTAL OCCUPATION	EXETER ACADEMY		U. OF C. HIGH SCHOOL		TOTAL	
	Number	Percentage	Number	Percentage	Number	Percentage
Proprietors	88	44.0	176	42.1	264	42.7
Professional service	62	31.0	130	31.1	192	31.0
Managerial service	21	10.5	50	12.0	71	11.5
Commercial service	15	7.5	41	9.8	56	9.0
Clerical service	5	2.5	8	1.9	13	2.1
Artisan-proprietors	3	1.5	5	1.2	8	1.3
Agricultural service	2	1.0	2	.5	4	.7
Manual labor	2	1.0	......	....	2	.3
Unknown	3	1.0	6	1.4	9	1.4
Total	201	100.0	418	100.0	619	100.0

Data were not secured from the entire population in either school, since it was felt that a random sampling would be sufficient for our purposes. As shown in Table LXIII returns were received from 201 students in Exeter and 418 in the University of Chicago High School.

THE PARENTAL OCCUPATION

As in the study of the public high school, the most significant thing here is the occupation of the parent or guardian. The facts for the two schools are presented in Table LXIII. A glance at this table makes it clear that the social composition of the student population in these schools is decidedly different from that of the public high-school population. And, furthermore, Phillips-Exeter Academy and the University of Chicago High School draw their students from almost exactly the same elements in the population. About the only difference worthy of mention is the slightly larger representation of the managerial and commercial workers in the latter and a correspondingly greater percentage of proprietors and clerical workers in the former.

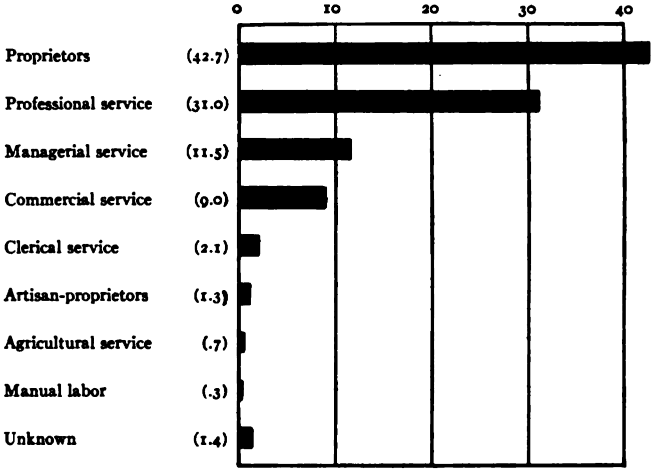

FIG. 39.—Showing by percentages the occupations of the fathers or guardians of 619 students in Phillips-Exeter Academy and the University of Chicago High School. June, 1921.

The percentages for the two schools combined are presented graphically in Figure 39. It will be observed that the proprietors have the largest representation, with 42.7 per cent of the students. Then follows the professional service with 31.0 per cent. No other group can be said to be well represented in these schools. Consequently it may be said that private secondary schools of the more exclusive type are organized practically for these two classes in the population. The relatively poor representation of the managerial service is perhaps surprising until it is recalled that quite a large proportion of the purely managerial positions are not high-grade positions and that many of the individuals holding these positions have been promoted from some form of skilled labor. Considering their numbers in the population the commercial workers have a fair representation, while the clerical workers are almost wholly absent. There are very few artisan-proprietors and farmers; and the many grades and varieties of manual labor combined account for only .3 per cent of the total enrolment of the two schools. It is probable that more detailed and comprehensive knowledge of these few cases would reveal the influence of certain special circumstances not ordinarily associated with manual labor.

It is interesting at this point to make a comparison with the public high-school population. This is done in Table LXIV. According to this table only two occupational groups have a greater proportional representation in the private than in the public secondary schools—the professional service and the proprietors. All the rest are less well represented, although only slightly so in the case of the commerical service. Then follow the managerial service, the clerical service, the

TABLE LXIV

Occupations of Fathers or Guardians of 17,265 Students in the Public High Schools of Bridgeport, Mt. Vernon, St. Louis, and Seattle, and 619 Students in the Phillips-Exeter Academy and the University of Chicago High School

Parental Occupation	High Schools of Bridgeport, Mt. Vernon, St. Louis, Seattle	Phillips-Exeter Academy and University of Chicago High School
Proprietors	19.8	42.7
Professional service	9.4	31.0
Managerial service	16.5	11.5
Commercial service	9.5	9.0
Clerical service	5.8	2.1
Artisan-proprietors	4.2	1.3
Agricultural service	2.4	.7
Manual labor	29.1	.3
Unknown	3.3	1.4
Total	100.0	100.0

artisan-proprietors, the agricultural service, and finally manual labor. It is in this last group that the most pronounced difference is to be found. While 29.1 per cent of all the students in the public high schools come from the laboring classes, only a negligible proportion of those in these private schools are from this source. Thus, while public secondary education in the United States is still highly selective, it is certainly much less so than private. And, assuming that these private schools do give us a relatively reliable picture of the social composition of our secondary-school population of a few generations ago, it is clear that we have traveled a considerable distance from the conception of secondary education as class education.

NATIVITY OF THE FATHER

The students in these two schools are very largely of American parentage. This is shown in Table LXV in which they are classified according to the nativity of the father. In the two schools combined 87.3 per cent of the fathers of the students were born in this country, and over one-half of the remainder were born in English-speaking countries. It will be noticed further that the south and east of Europe are practically without representation. These schools draw from the native stock and the peoples from the north and west of Europe.

TABLE LXV

NATIVITY OF FATHERS OF 619 STUDENTS IN THE PHILLIPS-EXETER ACADEMY AND THE UNIVERSITY OF CHICAGO HIGH SCHOOL

Country of Father's Birth	Number	Percentage
United States	540	87.3
Austria-Hungary	6	1.0
British Empire	41	6.6
France	4	.6
Germany	17	2.7
Ireland	3	.5
Italy	1	.2
Russia	3	.5
Scandinavia	2	.3
All others	2	.3
Total	619	100.0

NUMBER OF BROTHERS AND SISTERS

In view of the foregoing facts concerning occupation and nativity it is to be expected that the families from which these children come should be somewhat smaller than those from which the public high school is recruited. And such is the case to a small degree, as may be seen by examining Table LXVI. According to this table the median number of brothers and sisters is higher for the students in the public high schools in each of the cities than it is for those in either of the private schools. This figure is lowest in the University of Chicago High School, where it is but 1.3, and highest in the Bridgeport High School, where it reaches 2.3.

TABLE LXVI

MEDIAN NUMBER OF BROTHERS AND SISTERS OF THE STUDENTS IN THE PUBLIC HIGH SCHOOLS OF FOUR CITIES AND IN TWO PRIVATE SECONDARY SCHOOLS

Secondary Schools	Median Number Brothers and Sisters
Bridgeport	2.3
Mt. Vernon	2.1
Seattle	2.0
St. Louis	1.8
Exeter Academy	1.7
University of Chicago High School	1.3

In conclusion it should be pointed out that the differences between the public high school and these private secondary schools are actually greater than statistics indicate. In all probability, for example, there is an important average difference between the managerial service represented in the two types of schools. Fathers engaged in these occupations who send their children to the private school hold positions somewhat superior as a rule to those held by fathers similarly classed who send their children to the public schools. Many of those representing the managerial occupations in the high school are foremen while this grade is practically absent in the private school. The same may be said of each of the remaining occupational groups, when examined in the concrete. Thus we may conclude that, while the public high school is still a class institution in a very real sense, yet the great increase in the secondary-school population of the last forty years marks a considerable advance toward the democratization of secondary education.

PART III. CONCLUSION AND INTERPRETATION

CHAPTER XVI

THE SELECTIVE CHARACTER OF AMERICAN SECONDARY EDUCATION

In view of the foregoing analysis it is clear that we in America have not abandoned in practice the selective principle in secondary education, even though we have established a free public high school in almost every community in the country. It is not strictly in accord with the facts to say that "a public high school differs from an elementary school chiefly in the age of its children." It is true that children in high school are on the average somewhat older than those in the elementary school, yet, as a matter of fact, there is not very much difference in the ages of pupils enrolled in the eighth grade and those in the first year of the high school. High-school students, even today and in spite of the amazing growth of the high-school enrolment since 1880, are a highly selected group. And this difference is just as important as the difference in age. Secondary education is not education for adolescence, as elementary education is education for childhood, but rather education for a selected group of adolescents, as we have seen in the preceding chapters, and as we shall note again now in summary.

PARENTAL OCCUPATION AND THE PUBLIC HIGH SCHOOL

There is a close relation between parental occupation and the privileges of secondary education. If we examine the entire high-school population, we find certain occupational groups very well and others very poorly represented, in proportion to their numbers in the general population. Among the former are the five great non-labor groups with professional service occupying the most advantageous position, followed by the proprietors, commercial service, managerial service, and clerical service. At the other end of the series are the lower grades of labor with common labor almost unrepresented and personal service, miners, lumber-workers, and fishermen, and the miscellaneous trades and machine operatives in the manufacturing and mechanical industries, occupying somewhat better positions in the order named. The other occupational groups are found between these two extremes. Next to the non-labor groups are the printing trades and the public service, followed by the machine trades, transportation service, and the building trades. In general, the order here given reflects the social and economic status of the occupation, its educational and intellectual standards, and the stability of employment.

✓ Not only do these various occupational classes exhibit different degrees of representation in the high school at the beginning of the course, but those very groups that are under-represented in the Freshman year have the smallest ratio of Seniors to Freshmen. In fact, the representation of an occupation in the first year of the high school is at the same time a fairly accurate measure of its tendency to persist through the fourth year. Consequently, the differences among the groups become more and more pronounced in the successive years of the school. The student population gradually becomes more and more homogeneous as the source from which it is drawn becomes more narrow, until by the time the Senior year of the high school is reached, the student body exhibits a distinctly class character. Here the representatives of the laboring classes are few indeed in proportion to their number in the general population, and the lower grades of labor have practically disappeared. This is brought out in striking fashion by the data from Mt. Vernon in which the sixth grade is contrasted with the last year of the high school.

Evidence in corroboration of these conclusions, drawn from a study of the high-school population, is derived from the investigation of groups of children of high-school age not in high school in Seattle and Bridgeport. In the former city, a study of 514 children of high-school age at work showed a social composition very different from that of the high-school population. Here, four great labor groups—the building trades, common labor, machine trades, and transportation service—contribute over 60 per cent of the children. The situation is just the reverse of that found in the high school. In Bridgeport a similar condition is found. In the evening high school of that city the sons and daughters of the laboring classes constitute the great majority of the enrolment with the machine trades in the lead, followed by the miscellaneous trades, common labor, and the building trades. In the trade school the situation is about the same except that the representation of the laboring classes is yet larger and common labor forges ahead of the miscellaneous trades to second place. Apparently the children of the laboring classes are destined to follow in the footsteps of their fathers. This representation of the labor groups is still further increased in that group of educational unfortunates enrolled in the compulsory continuation classes in which common labor holds first place, accounting for over one-fourth of the entire registration.

These differences in the extent of educational opportunity are further accentuated through the choice of curricula. As a rule, those groups which are poorly represented in the high school patronize the more narrow and practical curricula, the curricula which stand as terminal points in the educational system and which prepare for wage-earning. And the poorer their representation in high school, the greater is the probability that they will enter these curricula. The one- and two-year vocational courses, wherever offered, draw their registration particularly, from the ranks of labor. This tendency is considerably more pronounced among the girls than among the boys. The former seem to be peculiarly bound by the social class from which they come. One is surprised at the unmistakable class character of the girls' college preparatory course in a high school such as that in Bridgeport. Furthermore, the thesis may be cautiously advanced that these differences appear somewhat more clearly in the East than in the West, but it is hardly safe to generalize on the basis of returns from four cities.

A study of expectations following graduation, as given by the students, indicates that this selective principle continues to operate beyond the period of secondary education. Those classes which are least well represented in the last year of the high school will apparently be yet less well represented in the colleges and universities. And, as in the case of the choice of curricula, this tendency is more marked among the girls than among the boys, in the East than in the West.

THE PUBLIC HIGH SCHOOL AND THE CULTURAL LEVEL

Parental occupation, as one index of cultural level, exhibits a close relation to educational opportunity. The same is true of the possession of a telephone in the home, according to the returns from Bridgeport and Mt. Vernon. In the former city, it was found that telephones are two and one-half times as frequent in the homes of high-school students as in those of children attending the trade school, and seven times as frequent as in the homes of the children in the compulsory continuation classes. Furthermore, the percentage of telephones increases decidedly from year to year in the high school. Thus we find but 39.7 per cent of the students in the Freshman year coming from homes with telephones, whereas in the Senior year, this percentage is 60.3. There are also wide differences among the curricula in this respect. In the case of the girls, telephones are almost twice as frequent in the homes of those who are enrolled in the college preparatory as in the homes of those taking the commercial course. And these curricular differences are less marked among the boys than among the girls as was observed in the study of the parental occupation. Data from Mt. Vernon, including returns from the sixth grade, support in every particular these conclusions drawn from the Bridgeport study.

THE PUBLIC HIGH SCHOOL AND FAMILY INFLUENCES

All the evidence brought to light in this study points to the importance of the family as a powerful factor in determining attendance at high school. The mortality of parents of high-school students is found to be considerably below the expectation for children of high-school age, and does not increase perceptibly from the Freshman to the Senior year. In fact, according to the returns from Mt. Vernon, the mortality of parents is appreciably higher among sixth-grade children than among students in the last year of the high school. An examination of the various groups of children of high-school age not in high school shows a much higher mortality of parents here than among high-school students. In the case of young people attending the evening high school in Bridgeport, the mortality of parents is extraordinarily high, more than two and one-half times as high as among those attending the day high school. Unquestionably the disorganization of the home through the death of a parent is reflected in the diminution of the opportunities of secondary education.

While the evidence is neither quite so clear nor quite so objective, apparently the engaging in remunerative employment on the part of the mother acts in the same way as the death of a parent. Comparisons made among the groups studied usually hold in the one case as in the other. Yet, it must not be forgotten that the working mother is usually just one element in a complex social situation.

The influence of the size of the family on educational opportunity is not altogether clear. On the average, those elements in the population who do not patronize the high school have larger families than those who do, but there is no evidence to indicate that the size of the family itself is a determining factor; for the number of brothers and sisters is no smaller among Seniors than among Freshmen, and the very large families have just as high representation in the last as in the first year of the high school. Likewise the very small families do not apparently increase their representation in the later years of the high school.

The order of birth seems to be a matter of more importance, although the complexity of the situation is hardly compatible with any but the most cautious of statements. Our clearest evidence, drawn from the four groups studied in Bridgeport, indicates that the firstborn has somewhat more limited chances of securing a high-school education than the lastborn child. It is on him particularly that the burden of family support is likely to fall, if one or more of the children must help to bear it.

THE PUBLIC HIGH SCHOOL AND THE IMMIGRANT

Returns from Bridgeport and Mt. Vernon indicate very clearly that children of native parentage attend the public high school in proportionately much larger numbers than do children of immigrant parentage. There are certain immigrant groups, however, that approximate, if they do not surpass, the native stock in their zeal for secondary education, altogether apart from the social and economic handicaps under which the immigrant labors. Among these, probably the Russian Jews stand at the top, followed by the Irish, the Germans, and the peoples of the British Empire. At the other extreme are the Italians, the Poles, and the races of the old Austro-Hungarian Empire who patronize the high school in exceedingly small measure. Disregarding the record of the Russian Jews, it may be stated as a general principle that the farther east and south we go in Europe, as the source of our immigrants, we find less interest in secondary education.

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The well-known tendency among our own people for the girls to patronize the high school in greater numbers than the boys is reversed among certain immigrant stocks. Thus, while in the Bridgeport High School there are but 74 boys of native parentage to every 100 girls, among the Italians this ratio of boys to girls is 154. This social trait, if such it may be called, varies much from group to group. Beginning with the Irish who exhibit the American trait in approximately its native strength of sending girls rather than boys to high school, the proportion of boys steadily increases as we pass east and south into Europe. Among the peoples of the "new" immigration the right of the girl to a secondary education is not recognized as on a parity with that of the boy.

In choice of curricula the girls of immigrant stock are clearly less inclined toward the college preparatory course than are the girls of native parentage. Curiously enough the reverse is true of the boys, but, since the boys of American parentage are exceptionally well represented in the scientific course, which in reality is a college preparatory course, no large significance should be attached to this difference between the foreign and native stock.

THE PUBLIC HIGH SCHOOL AND THE NEGRO

While for the country as a whole the proportion of negroes of high-school age to be found in our high schools is very small, in the city of St. Louis they do about as well as the whites. A study of the student population in the negro high school of this city helps us to understand the difficulties that stand in the way of educational achievement on the part of members of this race. The fathers of the students in this high school are for the most part engaged in manual labor, and the lower and less respectable grades of manual labor, particularly personal service and common labor. The negro family exhibits a large measure of disorganization, as indicated by such crude and unsatisfactory phenomena as a deceased parent or a working mother. In the high-school population of St. Louis the parental mortality for the negro children is well over twice as high as for the children of white stock, and the frequency of the working mother is between five and six times as great for the students of the one as for those of the other race. All of which makes it safe to conclude that nowhere else in the nation is there a similarly large representation of any other race living on the same social and economic level that is sending as large a proportion of its children to high school as the negroes of St. Louis.

The negroes exhibit in a pronounced fashion the American trait of sending a larger proportion of their girls than of their boys to high school. In choice of curricula, the negro girls differ from their white sisters chiefly in avoidance of the two-year commercial curriculum and in their very frequent selection of the home economics course. The negro boys avoid the general and concentrate on the manual training course. Following graduation, the negro girls expect to attend normal school and enter professional service in much larger numbers than do the whites. And they are not apparently looking forward to clerical service in proportionate numbers. Surprisingly, in the case of the boys, the only important difference between the two races is the much larger expectation of college attendance on the part of the negroes. It should be kept in mind, however, that these conclusions are based altogether on statements by the students, and consequently require considerable discounting.

THE PUBLIC HIGH SCHOOL AND PSYCHOLOGICAL SELECTION

Not only is the high-school population selected sociologically, but it is selected psychologically as well. Children of high-school age not in high school, whether they be in the evening high school, the trade school, or the continuation classes, show a lower intelligence rating on the average than do those in high school. But there is much overlapping in the distribution of ability for the two groups. There is much excellence out of, as well as much mediocrity in, the high school. The trade-school population shows a particularly wide distribution of ability.

In the high school itself the traditional academic curricula draw a higher type of ability, on the average, than do the newer and vocational curricula. Here also, however, the overlapping of the distributions is pronounced, and perhaps even more significant than the average difference.

The children from the laboring classes exhibit ability of practically as high grade as do those from the other occupational groups. This is probably due to the much greater elimination of children of labor parentage. Likewise the children of immigrants do about as well on the tests as do the children of native stock.

Firstborn make records somewhat superior to the records of lastborn children. This is probably to be explained in terms of greater elimination and thus more rigid selection among the former. The intelligence score also varies inversely with the size of the family. The explanation here is apparently to be found in the limitation of births among the more foresighted elements in the population.

THE POPULATION OF THE PRIVATE SECONDARY SCHOOL

In the population of the private secondary school, which charges a considerable tuition fee and which is fundamentally college preparatory in its function, we probably have as accurate a picture as we can get today of the sources from which the private academy drew its students before the rise of the free public high school. While this picture is certainly not accurate to the details, the general outlines in all probability do not falsify the facts.

Taking the student populations of Exeter Academy and the University of Chicago High School, we find the laboring classes practically absent, in contrast to a representation of 29 per cent in the public high school. Furthermore, these two schools draw almost three-fourths of their students from two occupational groups—the proprietors and professional service. Also almost 90 per cent of these students are of native parentage. Thus, while we may say that public secondary education is still highly selective, it is obvious that it has been and might be much more so.

CONCLUSION

Little need be said in conclusion. The story that has been told in the foregoing pages is not a new one. Misfortune, as well as fortune, passes from generation to generation. The children of unfortunate parentage are unfortunate, assuming here that the current secondary education is worth to the individual some fraction of its cost. The ancient adage, "To them that hath shall be given," is true today as in olden times. When not preserved through the operation of biological forces, the inequalities among individuals and classes are still perpetuated to a considerable degree in the social inheritance. While the establishment of the free public high school marked an extraordinary educational advance, it did not by any means equalize educational opportunity; for the cost of tuition is not the entire cost of education, or even the larger part of it. Education means leisure, and leisure is an expensive luxury. In most cases today this leisure must be guaranteed the individual by the family. Thus secondary education remains largely a matter for family initiative and concern, and reflects the inequalities of family means and ambition.

CHAPTER XVII

THE HIGH SCHOOL AND DEMOCRACY

More than twenty years ago John Dewey, in the opening paragraph of his *School and Society*, gave this expression to his conception of the ideal relation that society should sustain toward its children: "What the best and wisest parent wants for his own child, that must the community want for all of its children. Any other ideal for our schools is narrow and unlovely; acted upon, it destroys our democracy." With this ideal, properly interpreted, all believers in democracy are in sympathetic and complete accord.

At the present time, in the light of the facts revealed in this study, it is clear that we are very far from the realization of this ideal in our own country, at least in so far as secondary education is concerned. We are probably as near to it, if not somewhat nearer, than are the people of any other nation; and yet the facts do not set especially well with our professions of equality of opportunity, assuming of course that secondary education does increase an individual's chances for what we call success in modern life, as well as contribute to the general enrichment of life. In a very large measure participation in the privileges of a secondary education is contingent on social and economic status. In this connection, as in others, it would be difficult, in the thought of Bernard Shaw, to place too much emphasis on the need of a child's using wisdom in the choice of its parents; and yet, in view of the differential birth-rate, the number of chances of choosing the more highly educated and well-to-do parents is distinctly limited, and is gradually becoming more so.

UNIVERSAL SECONDARY EDUCATION

But it may be maintained that this ideal of equality of educational opportunity does not mean sameness of opportunity, nor does it mean necessarily equality in years of educational experience. Some natures, as certain soils, will respond to more intensive cultivation than others. Surely no one would defend the proposition that all persons should continue their education through the three years of the university graduate school in the interests of equality of educational opportunity. The endowment of the individual must be recognized in each case. The most that can be demanded in recognition of the ideal is that the potentialities of the individual be realized. It is obvious that the selective principle, resulting in elimination, must appear at some point in our educational system. But at what point should the principle appear, and under what conditions should it operate?

This really raises the question of the wisdom and justice of universal secondary education. In theory we are apparently rather definitely committed to the idea, although in practice we are yet very far from its realization, as this investigation shows. If the course on which we have embarked is unwise, it should be changed while there is time and in the light of a thorough analysis of the matter. Should Dewey's ideal apply to the period of secondary education? What is the place of secondary education in a democracy? Let us pass to the various considerations which these questions bring to mind.

THE FINANCIAL OBJECTION

It has been pointed out with truth that our people have embarked upon this ambitious program of secondary education without fully realizing the financial burden that such a program entails. The increase in high-school enrolment has ~~not~~ been ~~un~~attended by increasing costs. In fact today we hear from various quarters the complaints of the taxpayer as he is asked to meet increasingly heavy demands on his pocketbook for educational purposes. Undoubtedly a further extension of secondary education will mean greater educational costs. The education of all children of high-school age would probably involve four times the present expenditure, with no improvement in the quality of instruction. This statement of course disregards those economies that would be realized in the small high schools through a more intensive use of the present teaching staff and material equipment. This would result in an increase in the cost of secondary education to a figure somewhere between one-half and three-quarters of a billion of dollars. And in the minds of some people such expenditure is too stupendous to be entertained for a moment.

A further analysis is needed, however, to discover the real nature of this opposition to further educational expenditure. Is it that the economic system is unable to bear the added burden; that the methods of taxation are antiquated and not adapted to modern conditions; or merely that the people do not regard a further extension of secondary education as worth the cost? The first of these questions must certainly be answered in the negative. Any nation that can spend billions on armaments can spend a half billion on secondary education, if it so desires. A people that spends annually three billions of dollars on luxurious services, over two billions on tobacco and snuff, one billion on candy, and three-quarters of a billion on perfumery and cosmetics, need fear neither bankruptcy nor revolution by even quadrupling the present expenditure for secondary education. The economic system can bear it.

An affirmative answer to the second question can be as easily defended as the negative answer to the first. The methods of taxation for the support of education are antiquated and do not insure an equitable distribution of the burden. A century ago the property tax was fair, because property was tangible and usually a satisfactory index of an individual's ability to pay. Today the situation is quite different, due to industrialization and the increased complexity of an economic life in which property assumes many intangible forms and is no longer a fair index of ability to pay. The increase of educational costs demands, on the part of educators, close attention to the problems of taxation.

The third question is also an important and even basic one. We may at least say with assurance that, if the majority of the people want a further extension of secondary education, they will get it regardless of the cost, that is, if they want it as much or more than they want tobacco, snuff, candy, perfumery, cosmetics, and other things, for which they are spending their money now. Whether or not they want it will depend on two things: first, the value of secondary education; and second, their realization of its value. Both of these are, in large measure, problems for the educator. On the one hand, he must organize and administer secondary education in such a way and with such clarity of purpose that its value will be unequivocal and patent to the ordinary citizen without the interposition of educational sophistry and cant. Educational purpose and educational accomplishment must be stated in terms of those things that most people regard as valuable and worth while. On the other hand, the educator must inform the citizen that secondary education is so organized and so administered. Only when people are made to *feel* that education is as valuable as tobacco and cosmetics will they be as willing to spend their money for the one as for the other. But certainly the matter of cost is not in itself a sufficient reason for opposing universal secondary education.

PUBLIC SUPPORT OF SELECTIVE EDUCATION

There is another side to this question of finance that deserves attention. At the present time the public high school is attended quite largely by the children of the more well-to-do classes. This affords us the spectacle of a privilege being extended at public expense to those very classes that already occupy the privileged positions in modern society. The poor are contributing to provide secondary education for the children of the rich, but are either too poor or too ignorant to avail themselves of the opportunities which they help to provide. But it will be answered that the high school is supported by taxation, and that the poor do not pay taxes. This is obviously an unsound position to assume, since all people who wear clothes, eat food, and live in houses do pay taxes either directly or indirectly. Of course, no assumption is made here that all taxes are shifted to the consuming public, for they are not. Some are shifted altogether, others only partially, and still others not at all. The consumer does pay taxes, but not the consumer only—this and no more is assumed, but it is sufficient to warrant the foregoing statement.

It is sometimes said in extenuation of this condition that society as a whole profits from the education of the few through the superior service that the few render; and there is much that may be said in support of this theoretical position. In fact this is about the only justification for public support of higher and professional education, which are necessarily selective. Yet in practice it must be admitted that many individuals use the gifts of society for self-aggrandizement and are quite unconscious of any social obligation. This is particularly true of education in its various forms which has been regarded too much as a natural right or gift from God and too little as a preparation for social service. Indeed in many quarters it is even looked upon primarily as a means of avoiding the hard and disagreeable work of the world and a sure road to those callings that combine high remuneration and respectability with the comforts of life. Elementary education, which is guaranteed to all, may perhaps be regarded as a natural right, but secondary education, limited as it is, can be justified at all only in terms of the unqualified recognition on the part of the high-school student of the social obligation involved. There is no such recognition in the public high school today, although the narrow source of its students makes this obviously and peculiarly necessary.

THE PERIL TO SOCIAL STABILITY

In some countries the universalizing of secondary education would be viewed with alarm on the grounds that it would produce social instability and result in the disintegration of the established order.

Indeed, such a disquieting view has been taken by some foreign educators of the effect of our limited (though extensive in comparison with other countries) secondary education on American society. The idea back of this view is apparently that it is dangerous for any society to produce a larger number of trained minds capable of self-direction and critical thought than may be required to fill the customary positions of leadership. Unquestionably there is something in this argument, if we look at it from the standpoint of those occupying the strategic and privileged positions in the existing order and who may consequently be expected to lose through any change that might be effected. On the other hand, if we are interested in the welfare of the great mass of the people, there is nothing to fear in the universalizing of secondary education; in the very considerable increase in the number of individuals capable of thoughtful leadership in every class of the population; in the presence of larger numbers of persons qualified to serve as informed and critical followers in the various social groups. In other words, any individual or any class depending on special privilege of any sort for its position in society has good reason for fearing the further extension of secondary education; all others may look upon such change with equanimity. It is of course assumed that this further extension would take into consideration all differences in individual aptitude and interest.

THE PSYCHOLOGICAL DIFFICULTY

Perhaps the strongest objection to universal secondary education is the psychological objection, to which reference has been made in an earlier paragraph. The wide range of intelligence among children of a particular age is well known, and we may assume the same for other psychological traits. Nature has thus set limits to the educability of all her children. In some this limit is very low, as in others it is extraordinarily high; at the one extreme is the idiot who can profit but little from either experience or instruction, while at the other is the child of genius for whom the most difficult intellectual tasks are easy and whose hours of instruction are very productive. To the one, secondary education is out of the question, while to the other, it is scarcely the beginning of an education that will continue throughout life.

If, however, we think less in terms of the extremes, which account for but a small proportion of the total number of cases, and more in terms of the great mass of individuals in between, much of the force of this objection is destroyed. There are undoubtedly individuals at the lower end of the distribution for whom education during the adolescent years would be unprofitable, because intellectual maturity is already practically attained, and on a very low level. Just how high the intelligence level should be in order to profit from twelve years of instruction, which takes the child through the elementary and secondary schools, is a question as yet unanswered. For certain types of subject-matter the level obviously would be higher than for others. It seems reasonable to assume that, through the proper adaptation of subject-matter and methods of instruction, secondary education might be so administered as to be profitable for all except those who are clearly feeble-minded. This would of course involve a thoroughgoing departure from the curricula and methods of the conventional type, which are the legitimate offspring of the selective principle.

That there is some scientific justification for the psychological objection to universal secondary education is admitted, but such justification does not extend to present practice. Much might be said for a secondary education that is based frankly and definitely on the principle of psychological selection, but ours is not of that type. It is true, as this study shows, that on the average, high-school students exhibit a higher intelligence level than do those children of high-school age not in high school. But what is the explanation? That the high school has purposefully selected these individuals because of their superior ability? Not at all, or at least not altogether, by any means. It seems just as probable that the selection is sociological first and psychological second; that children enter and remain in high school because they come from the homes of the influential and more fortunate classes, and not because of their greater ability. It is the usual thing for these two to go together, but a society is conceivable in which by some chance the individuals in the upper social and economic strata incline toward intellectual mediocrity. In such a society, assuming the large parental influence in determining educational opportunity which characterizes our own system, the children in high school might represent on the average a lower type of ability than those on the outside. Admitting that this is an extreme statement of the case, it nevertheless contains a certain element of truth. The high-school population includes many individuals of mediocre and inferior ability, and the population of high-school age not in high school includes many of superior talent, although the proportion on the upper levels is larger inside the high school. At the present time we have neither universal secondary education, on the one hand, nor selection according to any defensible principle, on the other.

LITTLE PLACE IN INDUSTRY FOR ADOLESCENTS

One other consideration favoring a further extension of secondary education deserves mention. In the Cleveland vocational survey it was found that there is practically no place in modern industry for children under sixteen or seventeen years of age. Normally, below this age a child enters an occupation with but little profit to either himself or society. Since there is so much that needs to be done in preparing these young people for the many and varied responsibilities of citizenship, vocation, parenthood, and the other important activities of life, and since this can hardly be accomplished in the elementary school, it seems the part of wisdom to enrich their lives and equip them to become more useful members of society through the agency of the secondary school.

A BROADER PROGRAM NECESSARY

The methods to be employed in bringing the opportunities of secondary education to practically all adolescents, regardless of class distinction, can hardly be discussed here. Undoubtedly our compulsory-education laws will have to be extended beyond the period of elementary education, and several states are already leading the way. We shall have to abandon our conventional ideas of secondary education as necessarily involving a four-year school, or a six-year school as under the reorganization, in which students attend four to six hours in the middle of the day for five days of the week during some nine or ten months of the autumn, winter, and spring seasons. Pedagogical traditions and administrative conveniences will have to adapt themselves to the conditions of life. Whether or not the community will have to go beyond the provision of free tuition and free textbooks to at least a partial support of the student during his period of attendance at school is a nice question. In certain cities where poverty and ignorance are to be found in their most extreme forms the community will probably have to bear responsibilities that the home or the individual will carry in others. But these are matters to be determined in the light of experience.

CONCLUSION

In our march toward the educational ideal referred to at the beginning of this chapter and which is clearly compatible with the professed ideals of our democracy, we must recognize two principles. *In the first place*, up to a certain point in our educational system we must have practically complete attendance of all the children of the community with adequate provision for individual differences in ability, aptitude, and interest. Where this point should be is, in the main, an unanswered question, although there is some evidence that we shall place it well up into the secondary period and possibly at its close. The writer is inclined to favor the latter practice, because of the tremendous educational demands of an infinitely complex world that is rapidly becoming a single society. *In the second place*, beyond this point of complete attendance, in so far as public education is concerned, further education must rest on some objective basis rather than on the chances of circumstance and the whims of fortune. In theory today the public supports higher education for the purpose of securing trained persons to perform those important services that require special types of ability, knowledge, skill, and discipline. But no serious effort is made to discover the number of trained persons of each type required and the amount of training necessary in each case; nor is there a diligent search made through the lower school population for those special and superior types of ability that will most satisfactorily do those things that society wants done. Beyond the compulsory-school period a boy attends high school or college, not necessarily because of any special promise, but possibly because he is the only child of fond and well-to-do parents or because he likes football. To be sure, we make certain minimal demands of a formal sort, but the larger purposes of this selective education are obscured, and they will remain so until they are clearly defined and their implications find definite expression in practice and tradition. Why should we provide at public expense these advanced educational opportunities for X because his father is a banker and practically deny them to Y because his father cleans the streets of the city? We must distinguish between that education which is for all, and that which is for the few. At present our secondary education is of the first type in theory, and of the second in practice We must bring the theory and practice together: either open the doors of the high school to all children, and take care that all enter without favor, or frankly close its doors to all but a select group, adopt objective methods or selection, and teach to this selected group the meaning of social obligation. There is no other course that leads to democracy, that puts the high school at the service of every class without distinction, and at the same time renders the largest service to the entire community.

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